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FRIDAY, JANUARY 29, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
SECTION A, MATHEMATICS AND ASTRONOMY.

Vice-President—Otto H. Tittmann, Superintendent U. S. Coast and Geodetic Survey, Washington, D. C.

Secretary—Professor Laenas G. Weld, University of Iowa, Iowa City, Iowa.

Member of Council—Professor Ormond Stone.

Sectional Committee—Dr. G. B. Halsted, Vice-President, 1903; President C. S. Howe, Secretary, 1903; Superintendent O. H. Tittmann, Vice-President, 1904; Professor L. G. Weld, Secretary, 1904–1908; Professor W. W. Beman, one year; Dr. J. A. Brashear, two years; Professor J. R. Eastman, three years; Professor Ormond Stone, four years; Professor E. B. Frost, five years.

General Committee—Mr. Philip Fox.

Professor Alexander Ziwet, of the University of Michigan, was elected vice-president for the next meeting.

The Chicago Section of the American Mathematical Society and the Astronomical and Astrophysical Society of America met in affiliation with Section A. The papers presented before these affiliated societies will be noticed elsewhere. Those read before Section A were as follows:

A New Treatment of Volume: Professor GEORGE BRUCE HALSTED, Kenyon College, Gambier, Ohio.

In September, 1902, Poincaré wrote in his review of Hilbert's 'Grundlagen der Geometrie': "The fourth book treats of the measurements of plane areas. If this measurement can be easily established without the aid of the principle of Archimedes, it is because two equivalent polygons can either be decomposed into triangles in such a way that the component tri-

angles of the one and those of the other are equal each to each, or else can be regarded as the difference of polygons capable of this mode of decomposition. But we must observe that an analogous condition does not seem to exist in the case of two equivalent polyhedrons; so that it becomes a question whether or not we can determine the volume of the pyramid, for example, without an appeal more or less disguised to the infinitesimal calculus. It is, therefore, not certain that we can dispense with the axiom of Archimedes in the measurement of volumes. Moreover, Professor Hilbert has not attempted it.''

Professor Halsted, in the paper in question, has attacked the problem in the following manner:

The product of an altitude of a tetrahedron by the area of its base is the same whichever of the four faces may be chosen as base. This product is, therefore, a 'natural invariant' of the tetrahedron and may be designated as its volume, except that in order to adjust the conception to our ordinary numerical scale the factor *one third* is arbitrarily introduced. After defining a transversal partition of a tetrahedron as one made by a plane through an edge and a point of the opposite edge, it was shown that, however this solid be cut by a plane, the partition can be obtained as a result of successive transversal partitions, using not more than two other planes.

The above being explained, it was shown that the volume of any tetrahedron is equal to the sum of the volumes of all tetrahedrons which result from any set of transversal partitions. This need not be assumed as self-evident, but may be demonstrated as a necessary consequence of the so-called 'betweenness' assumption with reference to three co-straight points. Similar principles were deduced for polyhedrons in general, and by their use a general theory of volume was built up without reference to the ordinary notions of ratio and commensurability. The same method of treatment may be applied to figures in hyperspace of any order.

Lines on the Pseudosphere and the Syntractrix of Revolution: E. L. Hancock, Purdue University, Lafayette, Indiana.

The lines of the pseudosphere are reviewed and those of the syntractrix of revolution studied. The latter surface S_1 is defined as the surface generated by the revolution of the curve C_1 about its asymptote; C_1 being determined by laying off a constant distance d on the tangents of the tractrix.

The geodesic, asymptotic and loxodromic lines on S_1 are worked out and studied by classifying the surfaces according as

$$d \gtreqless 2c,$$

c being the constant of the tractrix. When $d \geqq 2c$ it happens that the geodesic lines on S_1 are all real; while for $d < 2c$ they are real or imaginary according as

$$\kappa^2 \lesseqgtr \left| \frac{c^2 d^2}{d^2 - 4cd} \right|,$$

κ being a constant of integration.

The loxodromic lines of the syntractrix of revolution are represented in the plane by the same system of straight lines as represent the loxodromic lines of the pseudosphere.

The Rotation Period of the Planet Saturn: Professor G. W. Hough, Director of Dearborn Observatory, Evanston, Ills.

In 1877 Professor Asaph Hall, then at the U. S. Naval Observatory, observed a spot near to Saturn's equator and by its means determined the period of the planet's rotation. From that time on, until the recent opposition, no well-defined spot has been visible. On June 23, 1903, however, Professor E. E. Barnard, of the

Yerkes Observatory, noted a large and distinct spot in Kronocentric latitude 36°.5. This was observed micrometrically on June 27 and July 13.

Acting upon the request of the author, micrometric observations of spots on Saturn were made by Professor S. W. Burnham with the 40-inch Yerkes equatorial. Measurements were secured on July 29 and August 15. From these data the 'mean' rotation period deduced was $10^h\,38^m\,27^s$; but the observations showed the period to be variable. The value $10^h\,38^m\,18^s + n \times 0^s.1856$ was found to satisfy all the observations with a mean error of $\pm\, 0^m.8$. In the formula n is the number of rotations of the planet counting from the epoch of the discussion, June 23, 1903.

An Extension of the Group Concept: Dr. EDWARD KASNER, Columbia University, New York.
Read by title.

Facilities for Astronomical Photography in Southern California: E. L. LARKIN, Director of Lowe Observatory.

Attention was called to the fact that, from May 1 to November 1, the observer upon Echo Mountain enjoys an almost unbroken succession of cloudless days and nights. During the greater part of this season the air becomes remarkably steady shortly after sunset; so much so that the rings of Saturn may be seen rising as a minute but sharply defined arch over the crest of the neighboring mountain ridge. In the rainy season, after a shower, the air is of such transparency that mountains distant a hundred miles or more may be seen with clearness and distinctness.

In view of these conditions Mr. Larkin urged the establishment of an observatory equipped for astro-photography upon the summit of Echo Mountain. Attention was called to the faint nebulous light forming the background of large regions of the sky as observed from this station. Some interesting views of Lowe Observatory and its surroundings were projected upon the screen, together with a number of the famous Lick Observatory photographs.

Coincident Variations: LUCINUS S. MCCOY, Whitten, Iowa.
Read by title.

On the Generalization and Extension of Sylow's Theorem: Dr. G. A. MILLER, Stanford University, California.

Dr. Miller's paper, which will shortly be printed in full, is in abstract as follows:

Let p^α be the highest power of p which divides the order of a group (G), and suppose that a subgroup (P_α) of order p^α contains only one subgroup (P_β) of order p^β and of a particular type. It is proved that the number of subgroups of G which are of the same type as P_β is of the form $1 + kp$, and that all of these subgroups form a single conjugate set. Hence the order of G is of the form $p^\beta h_1(1 + kp)$ where $p^\beta h_1$ is the order of the largest subgroup of G which transforms P_β into itself. By letting $\beta = \alpha$ we have Sylow's theorem. When $\beta = \alpha$ the factor h_1 is not divisible by p while it is divisible by p for all other values of β. Some simplifications of the proof of Frobenius's extension of Sylow's theorem are also considered.

The Supporting and Counter-weighting of the Principal Axes of Large Telescopes: C. D. PERRINE, Lick Observatory, Mt. Hamilton, California.

In large telescopes it is necessary to reduce the friction of the axes in their bearings. This has usually been done by a system of friction wheels held against the axis by weights and levers.

Experience with the roller bearings used in the driving-clock for the new mounting

of the Crossley reflector suggested the same principle as being suitable for the axes of large telescopes. These bearings are very simple in construction and consist of a ring of hardened steel rollers around the axis, in the bearing. The rollers fit closely about the axis and, therefore, do not require any frame to hold them in their relative positions. There is no looseness and the axis revolves with perfect accuracy, yet easily.

Such bearings would be fully as efficient in the case of a large overhang of the polar-axis as in the ordinary form of mounting. Where the ends of the polar axis are supported on separate piers the bearings can be made self-aligning.

A Linkage for Describing the Conic Sections by Continuous Motion: J. J. Quinn, Warren, Pa.

This linkage is the material embodiment of the facts set forth in the following theorem:

If one vertex of a movable pivoted rhombus be fixed in position, while the opposite vertex is constrained to move in the arc of a circle, the locus of the intersection of a diagonal (produced) through the other two vertices, with the radius (produced) of the circle in which the vertex moves is a conic.

If the fixed vertex is in the diameter of the circle, and the directing radius finite, the locus is an ellipse. If the directing radius is infinite and the fixed vertex in the diameter, the locus is a parabola. If the directing radius is finite, and the fixed vertex is in the diameter produced, the locus is a hyperbola. Modifications of the essential features of this linkage give rise to many interesting corollaries involving the geometric construction of the conics, their tangents and normals.

Circles Represented by $\mu^3P+L\mu^2Q+M\mu R+NS=0$: T. R. Running, Ann Arbor, Michigan.

In the equation discussed μ is a variable parameter; L, M and N are constants; P, Q, R and S represent circles. The equation itself represents circles for all values of the parameter. Three circles of the system pass through each point of the plane. The locus of the centers of the system is a cubic having eight arbitrary constants.

There will be a circle orthogonal to the system if any one of the circles P, Q, R, S can be derived linearly from the other three. There are six point circles in the system, all lying upon the locus of the centers. Four circles of the system are tangent to any one. Eight pairs of tangent circles have a common linear relation connecting their parameters.

The envelope of the system is

$$18LMNPQRS-27N^2P^2S^2+L^2M^2Q^2R^2-4(L^3NQ^3S+M^3PR^3)=0$$

which may be written

$$B^2=4AC,$$

where

$$A=L^2Q^2-3PMR,\quad C=M^2R^2-LQNS,$$
$$B=LMQR-9PNS.$$

It is shown that this is the envelope of

$$\mu^2A+\mu B+C=0,$$

A, B, C being bicircular quartics which are themselves envelopes of systems derived from the original circles.

The envelope of the radical axes of a particular circle and other circles of the system is a conic. This conic may be said to correspond to the particular circle, and there is such a conic corresponding to every circle of the system. The system of circles represented by

$$\mu^3P+L\mu^2Q+M\mu R+NS=0$$

is called the primary system, and the sys-

tem of conics corresponding to it in the manner above explained, the secondary system. It is shown that the equation of a conic of the secondary system is of the fourth degree with respect to the parameter and that, therefore, four conics of the secondary system pass through any particular point in the plane.

The equation of the radical axis of two circles, μ and μ', of the system is

$$y = \frac{F}{G}x + \frac{H}{G},$$

F and H being of the fourth degree in μ and μ' and G of the third degree. It thus appears that there are sixteen sets of values of μ and μ' for which this equation represents the same radical axis; that is, there are sixteen pairs of circles having the same radical axis. Moreover, to these thirty-two circles there correspond thirty-two conics of the secondary system, all of which are tangent to the same radical axis.

The paper includes, by way of introduction, a brief discussion of the equation

$$\mu^2 P + L\mu Q + MR = 0.$$

A New Type of Transit-Room Shutter: Professor DAVID TODD, Amherst, Massachusetts.

The type of shutter here described is that used to cover the two transit slits of the new observatory of Amherst College. These slits have a clear opening of 100° each way from the zenith and are three and one half feet in width. Each shutter is twenty-one feet long and sixteen feet high. It is made of structural steel with two vertical members and one truss member across the roof. Its weight is about three thousand pounds.

The entire shutter moves as a unit upon ball-bearing rollers underneath the vertical members. These rollers travel upon rails lying east and west along the north and south walls of the building. The two ends of the shutter are made to travel in unison by means of rack and pinions with sprocket wheels and link-belt chain.

The roof-member travels ten inches above the roof of the transit room, thus clearing all ordinary depths of snow. Only the bottom of this member is covered in, the structural elements of its top and sides being left exposed as in bridge work. Wind thrust is thereby minimized.

The entire shutter opens or closes full width in four seconds, by eight turns of a hand wheel. A small shaft lock holds it firmly in either position.

LAENAS GIFFORD WELD,
Secretary.

SECTION G, BOTANY.

SECTION G at the St. Louis meeting was organized, under the chairmanship of Professor T. H. Macbride, on December 28, 1903. The other officers were as follows:

Secretary—F. E. Lloyd.
Councillor—Wm. Trelease.
Sectional Committee—T. H. Macbride, vice-president, 1904; F. E. Lloyd, secretary, 1904–1908; F. V. Coville, vice-president, 1903; C. J. Chamberlain, secretary, 1903; W. A. Kellerman (one year), F. S. Earle (two years), C. E. Bessey (three years), W. T. Beal (four years), F. E. Clements (five years).
Member to General Committee—C. L. Shear.

Meetings of the section for the reading of papers and for other business were held on December 28, 29, 30, 31 and January 1. The Mycological Society and the Botanists of the Central States met conjointly with the section.

A committee consisting of Professor C. E. Bessey, Dr. B. T. Galloway and Professor C. MacMillan drew up a resolution strongly endorsing the efforts at present being made looking toward the passage of such laws by Congress as will provide for the perpetual preservation of the Calaveras Grove of Big Trees in California.

On Friday morning the section, together

with visiting botanists, had the pleasure of paying a visit to the Missouri Botanical Garden, where, under the guidance of Dr. Wm. Trelease and his staff, the various appointments and collections were examined with great profit and enjoyment. The section returned a vote of thanks to Dr. Trelease for his courtesy to the visiting botanists.

The following papers were presented:

The Work of the Year 1903 in Ecology: H. C. Cowles. (By special invitation of the sectional committee.) This paper will be published in full in Science.

Notes on the Botany of the Caucasus Mountains: C. E. Bessey.

General characteristics of the mountains and their climate. The steppes north of the range. The vegetation of Kislovodsk, Bermamut, Kasabek and Ardon, on the north side. Vegetation of the Ardon Valley, the higher mountain slopes and the Rion Valley to Kutais. The forests of Colchis. Tiflis and its botanical garden. The region of Upper Armenia. The plains of Erivan on the Zenga River. The gardens at Batum and Chackva. Tea plantations and bamboo thickets at Chackva. The forests of the northeast shores of the Black Sea.

The Cypress Swamps of the Saint Francis River: S. M. Coulter.

The Saint Francis River covers wide stretches of lowland in Missouri and Arkansas with a varying depth of water. At some seasons these lands are dry, at others covered with two feet of water. Submerged aquatic plants cover the river bottom and *Polygonum densiflorum* seems to be the first aerial plant; *Zizaniopsis miliacea* succeeds it very closely; *Peltandra undulata, Saururus cernuus* and *Typha latifolia* are next in order, then a willowy undergrowth, succeeded by *Cephalanthus occidentalis; Nyssa uniflora* and *Taxodium distichum* occupy the next zone and are the principal forms which have worked out so-called adaptations to their habitat.

The young trees of *Nyssa uniflora,* the tupelo gum, are crowded in pure groves, and as they increase in size they develop a peculiar bulging in the trunk near the water line. These dome-shaped bases become as much as twelve feet in diameter and are accompanied by the decay of the central tissue in base and trunk. Upper portions of the trees are usually blown away, leaving a hollow shaft thirty or forty feet high. The habitat of the cypress is similar. The young groves are not so unmixed as those of the tupelo. The cypress base, instead of being dome-shaped, becomes conical, but does not decay in the center. The development of the cypress 'knees' or upward enlargements of the roots is another peculiarity of the cypress growing in water. They are enormously developed in the Saint Francis region, sometimes reaching a height of eight feet above the ground. When cypress grows under mesophytic surroundings, neither the enlargement of the base occurs nor the development of knees. Beyond the cypress-tupelo gum association is found a large variety of shrubs and trees. The tension line between the cypress and most broad-leaved trees seems dependent upon the amount of water; the cypress can live on land or water, but the other forms only on land. However, they are more vigorous under those favorable conditions and soon occupy the land to the exclusion of the cypress. These marginal forms include *Liquidambar styraciflua,* white and red oaks, sassafras, sycamore, *Celtis Mississippiensis, Nyssa sylvatica* and a large number of shrubs.

Ecological Notes on the Islands of Bermuda: S. M. Coulter.

The Bermuda Islands are composed of porous limestone with a thin covering of soil. The nature of this substratum prevents the accumulation of water excepting a few brackish ponds near the level of tide-water. Conditions of moisture and exposure are very uniform, hence plant associations are not large, nor do they vary widely. The largest ecological area comprises in a general way all the hillsides and slopes that have sufficient soil to support a large vegetation. Their appearance is somber on account of the large number of cedars which cover them. Two species of *Lantana* (called the Bermuda sage-brush) are associated with the cedars, and crab-grass and cape-weed cover the ground. Tall oleanders are marginal to the cedar groves and *Yucca alsifolia* is abundant along the cliffs. A second area comprises the rocky shores along the ocean, characterized by gnarled forms of *Conocarpus erectus, Borrichia arborescens, Solidago sempervirens* and *Opuntia Tuna.* A third area is formed by the sandy beaches and small dunes along the south shore. The sea blackberry, *Scævola lobelia,* is the most abundant form and *Ipomœa pes-caprœ* is almost as common, trailing its long vines over the sands and helping to bind them together. Secondary in importance are *Cakile æqualis, Tournefortia gnaphaloides,* the golden-rod mentioned above and the sea ox-eye, *Borrichia arborescens.* These mesophytic and xerophytic areas are most prominent, but there are two types of swamps to be noted. The Devonshire marsh was apparently once a large pond but there is little water left. Two species of *Sphagnum, Proserpinaca palustris, Typha latifolia* and *Eichornia* occupy the lower pools. *Hydrocotyle Asiatica* and *Herpestis monniera* are rooted in the mud. *Osmunda Cinnamomea* and *O. regalis* are abundant in somewhat drier places, while in the dry, peaty soil *Pteris aquilina cordata,* the cedar, palmetto and dog-bush are most common. The mangrove swamps about small inlets of the sea constitute the second hydrophytic area. The aerial roots from the limbs of *Rhizophora Mangle* and the curving prop-roots add considerable interest to these swamps. The seeds begin to grow on the trees, then drop into the mud, their pointed ends fixing them upright, while the growing roots soon penetrate the soil and a pair of leaves appear at the upper end. *Avicennia nitida,* the false mangrove, is associated with the true and along the tide-water margins are *Salicornia fruticosa, Statice Lefroyi, Sesuvium Portulacastrum* and *Coccoloba uvifera.*

A Lichen Society of a Sandstone Riprap: BRUCE FINK.

A general discussion of the conditions under which the society has developed and is now growing, including some statement as to amount of moisture in various portions of the riprap, amount of disintegration at various points and amount of exposure to sun and wind. Following this is a consideration of the ecologic conditions and resulting spermaphytic flora in the area, and the effect of these surroundings on the composition of the lichen society. Next in order is given a list of the lichen species of the society, followed by a discussion of the conditions under which each species is growing and the adaptations of each species to these conditions. Brief comparisons are made between this society and three others found on sandstone, and herein are shown some very marked responses between ecologic conditions and structural adaptations.

Relation of Soil to the Distribution of Vegetation in the Pine Region of Michigan: E. B. LIVINGSTON.

The study here reported is of about fifteen townships lying in Roscommon and

Crawford Counties, Michigan. The soils are classed as clay, clay loam, sandy loam, and sand, power to hold and lift water from an underground water level decreasing with the different soils in the order named. The region is glacial and consists of ridges and plains. The former are usually gravelly and sandy loam. The latter are loamy sand, clay or nearly pure sand. Some ridges are quite clayey. The vegetation is divided into (I.) upland and (II.) lowland types. Of the former are considered the following, named for the characteristic tree species: (1) The hardwood, (2) the white pine, (3) the Norway pine and (4) the jack pine. These types become more xerophytic in character in the order named. In general, the upland types follow in their distribution the distribution of the soils, the hardwood occurring on low clay plains, on swamp margins in loamy soil, and on certain plains of loam which are well covered with humus. The white pine occurs on certain ridges of clay loam and of clay and also on swamp margins in loam and clay. The Norway pine type is found on loamy sand plains and on the ridges of sandy and gravelly loam. The jack pine type occupies exclusively the well-washed sand plains. The only complicating factors in distribution are the effect of humus (which seems able to make even sand able to support hardwood) and the effect of the rise of the underground water level, as at swamp margins. The latter makes a sandy soil able to bear vegetation which would otherwise be found only in loam or clay. Analyses of the soil seem to show that its chemical properties are unimportant, that the real factor to determine distribution is the power of the soil to hold water, this power increasing with fineness of particles or with presence of humus.

Research Methods in Phytogeography: F. E. Clements.

(1) The use of simple and automatic instruments, photometer, psychrometer, thermometer, etc., in the exact determination of the physical factors of a habitat; (2) the study of the structure and development of formations by means of permanent and denuded quadrats, and migration circles; (3) experimental ecology in the field by moving plants from one habitat to another, or by modifying the controlling factor of a habitat; (4) experimental ecology in the plant house by equalization and control of physical factors.

Ensayo para la formacion de un foto-herbario Botanico y medico de la flora Mexicana: Fernando Altamirano.*

Contendrá una collección de 6000 fotografías tomadas de los especimenes del Herbario de Plantas Mexicanas del Instituto Medico Nacional. Cada fotografía será de y llevará dos etiquetas: una corresponderá al Colector y tendrá los datos de clasificación, lugar de vegetación, etc., y la otra corresponderá al instituto, conteniendo los nombres vulgares, las rectificaciones que se hayan hecho á la clasificacion, etc. Cada lámina del Foto-herbario, que contendrá 4 foto-grafías, irá accompanada de una hoja de igual temaño (0.20 por 0.25 próximamente), conteniendo datos descriptivos, aplicaciones y la distribución geográfica con su mapa respectivo. Las plantas del Herbario serán fotografiadas en órden de familias naturales, comenzando por las Ranunculaceas. Cada lámina contendrá solamente especies de un mismo género, especies que irán numeradas progresivamente, tal como se representa en la muestra que se remite, la cual comprende 100 fotografías. La impresión del texto y el tiro de las láminas, lo hará

* La palabra foto-herbario sera substituida por otra si se considerare inadecuada.

el Instituto, en número de 1,000 ejemplares, que repartirá en toda la República y á las corporaciones científicas extrangeras. El objeto de la publicación de este Foto-herbario es facilitar el conocimiento de nuestras plantas á toda clase de personas, aún de aquellas que sean menos versadas en la Botánica. Para eso se presenta la figura de la planta que atraé la atención y facilita las descripciones; y por eso tambien se dán á conocer las aplicaciones y el lugar donde vegeta una planta, lo cual aumenta el interés por conocerla y facilita su adquisición á los colectores. Formará pues, este Foto-herbari o un catálogo como el que acostumbran publicar los botánicos de sus herbarios; pero con la ventaje de que el Foto-herbario es un catálogo y un herbario á la vez, podriamos decir, acompañado de otras muchas notisias que no se acostumbra poner en los simples catálogos. Este Foto-herbario puede tener una aplicación más amplia todavía, y ese es mi deseo, que comprenda las Fotografías de todas las plantas mexicanas conocidas. Para consequirlo me propongo que tambien sean fotografiados los especimenes de los herbarios extrangeros que no tengamos en los de México. Asi por ejemplo, procurarémos fotografias de aquellas plantas mexicanas, de los herbarios de los Estados Unidos, de los de Europa, etc. A la vez que trabajemos en México se procurará que tambien se trabaje, sobre el mismo asunto, en los herbarios de fuera, siguiendo un plan determinado para que cuando al fin de algún tiempo (dos años probablemente) que se haya completado le colección de las fotografías de la Flora Mexicana, no resulten desordanadas ni haya repeticiones. Si pues se considerare útil la publicación del Catálogo del Herbario del Instituto, según la manera que he indicado, y que sea aplicable á toda la Flora Mexicana, procuraremos fotografiar cuanto antes, todas las plantas de los herbarios que haya en México, y yo me atreveré á pedir desde ahora la valiosísima cooperación de los botanicos de todas las naciones. Ojalá que esta autorizada Asociación tuviera á bien iniciar el monbramiento de una Comisión que se siriera dictaminar sobre cual seria la mejor manera de llevar á cabo la formación de un Catálogo General de la Flora de cada Nación ó sea un Foto-herbario-Pan-Americano.

The Alamogordo Desert; A Preliminary Notice: THOMAS H. MACBRIDE.

The Alamogordo Desert is situated in southwestern New Mexico; it is a bolson, *i. e.*, an undrained desert plain. The topography of the region and its geology are briefly described and an effort made by illustration and description to connect the present distribution of the flora with geological history. It is claimed that in this desert, as often in other parts of the country, the distribution problems can be understood only as the geologic story is more or less perfectly read. The flora of the plain is contrasted with that of the mountain side and summit.

The Flora of the St. Peter Sandstone in Iowa, An Ecological Study: B. SHIMEK.

The distribution of the St. Peter exposures in Iowa. The physical characters of the St. Peter sandstone. A brief discussion of the plants which are peculiar to it. A corresponding discussion of the plants which are common to rocky ledges and which also occur on the St. Peter sandstone. A more detailed discussion of a series of plants which normally belong to other habitats, but which have gained a foothold on the sandstone, or on the sands resulting from the decomposition of the sandstone. These latter are very much developed.

An Ecologically Aberrant Begonia: William Trelease.

An account of a Mexican species of *Begonia* possessing a single large sessile leaf closely applied to the cliff on which the plant grows, so as to afford protection to its roots.

Plant Formations in the Vicinity of Columbia, Mo.: Francis Daniels.

The vegetation of the region falls into four main classes: (1) The aquatic and subaquatic floras; (2) the mesophytic, or in poor soil, xerophytic, sylvan flora; (3) the rupestrine flora of the limestone cliffs; (4) the cultural and ruderal floras. The aquatic and subaquatic vegetation falls into six zones: The aquatic, amphibious, limose, ulignose (wet swamp), paludose (open marsh) and riparian zones. The mesophytic (or xerophytic) sylvan flora assumes five main types: The alluvial, the mesophytic sylvan proper, the open brush, the arborescent glade and the sterile hill type. The rupestrine flora exhibits four types: The fontinal or dripping rock, the soil-covered ledge, the bare rock and the cliff summit types. The cultural and ruderal floras have the forms proper to pastures, meadows, fields, orchards, gardens and waste places. Besides these there are a host of parasitic and saprophytic fungi, and a few flowering plants, like *Cuscuta, Thalesia* and *Monotropa.*

The Distribution of Some Iowa Plants; Formations on which they Occur: L. H. Pammel.

A brief account of some of the more important plants found on the carboniferous sandstone in eastern Iowa, noting the occurrence of the white pine, *Pinus Strobus, Gaylussacia resinosa, Aspidium marginale, A. acrostichoides, Lycopodium lucidulum, Phegopteris Dryopteris, Diervilla trifida* and *Danthonia spicata.* The occurrence of boreal types like *Salix candida, Lobelia Halmii, Cnicus muticus, Gentiana crinita.*

The Chemical Constituents of a Soil as Affecting Plant Distribution: S. M. Tracy.

The author calls attention to the fact that the distribution of plants is often attributed wholly to the physical and mechanical condition of the soil, though in many cases the chemical constituents of the soil are equally potent.

Vegetation of the North Shore of Lake Michigan: C. MacMillan.

A brief sketch of the characteristic shore and forest vegetation of the North Shore. The strong resemblance of this to the mountain vegetation of British Columbia was pointed out. Not only does the resemblance appear in the many northern species, but more particularly in the general association of plants and the relative preponderance of generic types.

Zones of Vegetation About the Margin of a Lake: W. J. Beal.

About a mile and a half northwest of Lansing, Mich., is a natural pond which goes by the name of Jones' Lake with an outlet at the west. The lake is nearly circular in outline and about forty rods in diameter. There is a slight extension both to the north and to the south. The bottom and the shaky margins all around consist uniformly of dark mud, ooze or muck. The lake contains a few species of fish, such as sunfish, blue gills and spotted bass. From the soft banks within two to three rods, the bottom uniformly descends rapidly to deep water. I examined the margins of this lake on August 23, 1903. Beginning with the deep water this is the order of the bands of some of the leading

kinds of plants: (1) Potamogetons, not yet in fruit, prominent among which was *Potamogeton amphifolius* Tuckerman, which formed an unbroken band about the margin of the lake. (2) In most places a narrow strip of some species of *Chara*. (3) *Castalia tuberosa* (Paine) Greene, and *Nymphæa advena* Soland, usually mixed, but sometimes only one or the other, formed a band ten to thirty feet in width, and this band was rarely broken, and then only for a space of ten to thirty feet. (4) In many places were narrow patches of *Pontederia cordata* L., but scarcely ever in long strips. (5) *Typha latifolia* L., with very rarely an exception of a few feet, formed a band from five to twenty feet in width. (6) Sedges in variety with some species of rushes and grasses, and others of like needs formed an uninterrupted band. (7) Several species of *Salix*, or some one or two, surrounded the lake completely. (8) A band of *Larix laricina* (Du Roy) Koch was unbroken excepting for a few rods on the north, where it may have been formerly cut away next to a cleared farm. As the condition of the margins of the lake and surrounding it are so nearly uniform, we have reason to expect the zones of vegetation will be little if at all interrupted. As the descent of the bottom from the flat margins of the lake to the deep water are so rapid, there is only room for narrow zones of vegetation. Beyond the eighth zone (of *Larix*) in two places for a quarter of the circumference the slope rises rapidly to dry arable land, while in the remaining three fourths there are many kinds of aquatic and lowland plants. In all his travels, the author never remembers to have seen a place where so many zones of plants were so well marked for so long a distance as were found at Jones' Lake.

The Genus Harpochytrium, its Development, Synonymy and Distribution: G. F. ATKINSON.

Describes the genus *Harpochytrium*, its structure, formation of sporangia and spores; the movement of the spores and attachment to host. Also discusses the synonymy as well as the distribution of the genus in different parts of the world.

The Phylogeny of the Lichens: F. E. CLEMENTS.

(1) A general consideration of the underlying principles of polyphylesis; (2) a detailed discussion of the points of contact of fungi and lichens; (3) the treatment and classification of lichens as parasitic fungi.

The Necessity for Reform in the Nomenclature of the Fungi: F. S. EARLE.

Cites the conflicting usages in Engler and Prantl's 'Pflanzenfamilien' and in Saccardo's 'Sylloge Fungorum' to show that there is no unanimity in the use of genus names for fungi at the present time. Shows from unpublished data in regard to the types of the earlier genera that in forty-five per cent. of these cases the earliest available name is not used by Saccardo. Shows that this process of shifting generic names from one group of species to another is still in progress and urges that immediate steps be taken to put a final stop to the practice.

Taxonomic Value of the Spermogonium: J. C. ARTHUR.

The physiological significance of the spermogonium is yet unknown. It had been tentatively assumed to be associated with sexual reproduction as the male structure. It has been known for more than fifty years, and it still bears the name given by the discoverer, Tulasne, but its sexual character is still problematical.

The numerous forms of spores among the Uredineæ are shown to belong to two classes, the teleutospores, which are doubtless of a sexual character, and conidia, the latter being either æcidia or uredo. These follow in an invariable order. The spermogonium always appears in the life cycle as the first fruiting structure. If the first subsequent spore structure is the uredo, there is no æcidium in the cycle; if it is in the teleutospore, there is neither æcidium nor uredo. The presence and association of the spermogonia, therefore, furnish important information regarding the extent of the life cycle. The characters drawn from form, size and origin of the spermogonia furnish minor characters. The spermogonia, as well as any or all of the conidia, may be suppressed in certain species.

Proof of the Identity of Phoma and Phyllosticta on the Sugar Beet: George G. Hedgcock.

This paper gives the results of a cultural study of *Phoma betæ* and *Phyllosticta tabifica* in which two fungi are shown to be identical, both causing a similar rot of the root of the sugar beet, and producing upon inoculation upon the leaves the typical *Phyllosticta* leaf spots. The cultural characters of the two fungi are identical.

Craterellus taxophilus, A New Species of Thelephoraceæ: C. Thom.

A delicate fleshy *Craterellus* found at Ithaca, N. Y., is described and figured as new. Photographs, specimens and drawings of structure are presented, and show it to differ from previously described species. Its association with *Taxus,* which seems very close, is made the basis of the specific name. The technical description of the species as *Craterellus taxophilus* is added.

The Fungi Cultivated by Texas Ants: A. M. Ferguson.

The fungi found in the so-called 'mushroom gardens' of certain fungus-eating ants occurring in central and southern Texas (*Atta fervens* Say, *A. septentrionalis* McCook, *A. turrifex* Wheeler and *Atta* n. sp. Wheeler) consist of a white slow-growing mycelium with characteristic clusters of terminal swellings, the 'Kohlrabihäufchen' of Möller, which are eaten by the ants. While no kind of spore formation was found, it is probably the same as the form described by Möller from the gardens of Brazilian *Attas.* The fungus grows slowly in culture, but was often more vigorous than in the garden under the control of the ants. The formation of the characteristic swellings seemed to be governed by local conditions (probably controlled in the garden by the ants), for in cultures, on beans, for example, they would be formed in abundance in some tubes and not at all in others. Efforts to feed one species with the fungus grown in the garden of another, or from cultures, gave erratic results, rarely succeeding, and then only after prolonged starving. Some observations of Möller bearing on the systematic position of the fungus were unconfirmed. A *Dematium*-like fungus proved to be the organism cultivated in the nests of *Cyphomyrmex rimosus.* This ant was supposedly carnivorous until its fungus-feeding habit was observed by Dr. W. M. Wheeler. In this case caterpillar pellets are used exclusively by the ants for a medium upon which to grow the fungus.

Symbiosis in Lolium: E. M. Freeman.

In a previous paper I have described the unique year-cycle of the fungus symbiont of *Lolium temulentum* and other species of *Lolium.* Further experiments support the theory that the fungus does not form spores. There are two races each, of *L.*

temulentum, L. perenne and *L. linicola,* one with and one without the fungus symbiont. Of these the with-fungus race is the slightly more vigorous. Present knowledge points to the probability that the fungus is an *Ustilagene,* which has lost its power of spore formation and has adopted a method of intraseminal mycelial infection at the first appearance of the stem growing point. Infection of without-fungus plants seems impossible, as is also the elimination of the fungus from the with-fungus plants.

Mitotic Division of the Nuclei in the Cyanophyceæ: EDGAR W. OLIVE.

The 'central body' in the Cyanophyceæ is a nucleus, not essentially different from the nuclei of higher plants. When conditions for growth are favorable, the vegetative cells divide with unparalleled rapidity, so that their nuclei are rarely in a state of rest. Consequently during this period of mitotic division a nuclear membrane is not present. In spores and heterocysts, on the other hand, the nuclei form nuclear membranes and they resemble, furthermore, in other respects the resting nuclei of the higher plants. When in division, the 'central body' is made up, for the most part, of a more or less dense kinoplasmic achromatic substance, which corresponds to the spindle, and which is composed both of mantle fibers, attached to the partition walls of the cell, and of connecting fibers. The chromosomes, which can be successfully demonstrated only by careful differentiation of stained material, are very minute, and are usually sixteen in number. In the large species *Oscillatoria princeps* and *O. Froehlichii,* however, there are thirty-two, while in *Nostoc commune* and in *Gleocapsa polydermatica* there are but eight chromosomes. In *Gleocapsa* the plane of division of the chromosomes is exceptional, in that it takes place at right angles to the resulting plane of division of the cell. In all the other forms studied, embracing five genera, the plane of division of the chromosomes is normal, being parallel to the resulting plane of division of the cell. In the filamentous forms division of the cells takes place with wave-like regularity; and in all cases studied, with the exception of *Gleocapsa,* division of the cell is accomplished by the growing in from the peripheral wall of a ring-formed wall. In *Oscillatoria* several ring-shaped walls, in different stages of growth, may be present at the same time in the same cell, long before the one first formed has completely divided the cell. Two kinds of granular inclusions, which are characteristic of the Cyanophyceæ, the cyanophycin granules and the slime globules, or 'central granules,' are usually present in the cytoplasm. The peripheral position of the cytoplasm is generally differentiated into a denser, fibrous region—the chromatophore—which contains the diffused green and blue coloring matters. No evidence whatever was found of the presence of minute globular chloroplasts, such as several investigators say are present in certain forms. In this investigation the conclusion was reached that the cell organization of these low plants can not be successfully studied except in thin sections, cut longitudinally as well as crosswise.

Chemical Stimulation of Algæ: E. B. LIVINGSTON.

The study was carried on with the polymorphic form of *Stigeoclonium* previously worked with by the same author. In the previous work it was shown that with relatively high osmotic pressure of the medium the alga produces only spherical cells, a *Palmella* or *Pleurococcus* form. With low osmotic pressure it grows out with long branching filaments. Zoospores are formed

only with low osmotic pressure and they germinate to form filaments. If filaments are placed in a medium of high pressure they break up into round cells or form groups of round cells. When the solution of low osmotic pressure has added to it a trace of such a poison as nitric or sulfuric acid, copper sulphate, silver nitrate, etc., the alga takes the *Palmella* form as though the pressure were high. If the poison is still more dilute there is a stimulation of zoospore production, though the zoospores are checked in germination. Nitrates and sulphates were used and it appears that the poison kations have the effect of producing the *Palmella* form in a solution whose osmotic pressure is far too low to bring about this result. The kations so far studied are: H, Li, Rb, NH_4, Cu, Ag, Al and Fe. All of these also produce stimulation of zoospore production when in weaker solution, and to the list may be added Ba and Sr.

The Differentiation of the Strobilus: F. E. Clements.

(1) A brief consideration of the antithetic evolution of the sporophyte from *Tetraspora* to *Anthoceros;* (2) a discussion of the probable origin of *Selaginella* and *Isoetes;* (3) the derivation of the strobilus of *Pinus, Myosurus* and *Alisma* from *Selaginella;* (4) the general ecological principles involved in the modification of the strobilus; (5) the essentials of the phylogenetic method.

The Histology of Insect Galls: M. T. Cook.

The function of the gall is to furnish nutrition and protection for the larva. The simplest galls only show two zones, the inner nutritive and the outer protective. The most highly developed galls show four zones, the second and third often separated; the innermost zone is nutritive and the other protective. When the gall first forms it is a mass of irregular parenchyma cells which soon become differentiated into the zones. In the simplest galls, where we have only two zones, the inner nutritive zone is rich in protoplasm, starch, etc., until the insect is near maturity, while the other zone forms tannin. In the most highly developed galls, tannin is also developed in abundance. The innermost zone is very rich in nutrition, the remaining three zones are protective. The separation of the second and third zone is undoubtedly a protective device. The shape of the gall and its complexity are probably due to efforts for protection against parasites and birds.

Morphology of Caryophyllaceæ: M. T. Cook.

Some time since the writer published a short paper on *Agrostemma Githago* L. and *Claytonia Virginica* L. Among the most interesting points in these papers was the formation of the peculiar beak to the ovule and the two zones of the nucellus in *A. Githago.* The writer has since continued the study upon two species of the Caryophyllaceæ for the purpose of demonstrating the importance, if any, of the morphology of the embryo sac and surrounding structure in taxonomy. The two species selected for study were *Vaccaria Vaccaria* (L.) Britton and *Alsine pubera* (Michx.) Britton. In both cases a beak is formed similar to *A. Githago* and the embryo follows a similar line of development, but the sac enlarges in the same manner and direction as in *C. Virginica.* Other points are as yet not definitely determined.

The Phylogeny and Development of the Archegonium of Mnium cuspidatum: G. M. Holferty.

After brief statements in regard to the collection and method of treatment of material, and the terminology to be used, the author reviews the more important litera-

ture on the development of the moss archegonium from 1851 to the present. A summary of this literature shows considerable divergence in the opinions and interpretations of the several investigators. The crux of discussion has been in respect to the origin of the members of the axial row, but particularly whether the terminal cell (cover cell of liverworts) adds to the row after its first division. The discovery of a mitotic figure in this cell after one cell had been cut off enables the writer to decide this question affirmatively. In a second part of the paper, the author demonstrates the homology of archegonia and antheridia from the standpoint of (*a*) homology of the organs as indicated in early stages of development; (*b*) homology of the egg and other members of the axial row; (*c*) the homology of the members of the axial row and sperm mother cells. From certain bisexual organs, and from abnormal or slightly modified forms of both archegonia and antheridia, the author is able to offer support to recent views as to the phylogeny of the archegonium and to throw light upon the meaning of abnormal forms, and particularly to groups of cells at the apexes of certain archegonia for which up to the present no adequate interpretation has been suggested.

The Enzyme-secreting Cells in the Seedlings of Zea Mais and Phœnix dactylifera: HOWARD S. REED.

During the process of germination, the above-named seedlings produce an enzyme for the solution of endosperm. The enzyme is secreted from a differentiated layer of cells. These cells show continuous morphological changes during the time the enzyme is being secreted. When secretion begins the cells of the secreting layer are full of the fine proteid granules, which are thought to be zymogen, because, as secretion progresses, they constantly disappear. In the early stages of secretion the nuclei of the secreting cells of *Zea Mais* are found in the basal end of the cell; in the later stages they are in the apical end next the endosperm layers. As secretion progresses, there is a continuous increase in the amount of chromatin in the nuclei of the secreting cells. At the same time the nucleoli decrease in size and staining properties. At the end of the process the protoplasm of the secreting cells breaks down and the products of disintegration disappear from sight.

Discoid Pith in Woody Plants: F. W. FOXWORTHY.

Discoid Pith: Any pith which is interrupted at frequent and tolerably regular intervals by transverse partitions dividing the pith up into a series of chambers. These partitions, disks, diaphragms, plates or lamellæ, as they are variously called, may be composed either of thick-walled or of thin-walled cells, and the spaces between the disks may be empty or filled with cellular tissue. Thus, M. Gris classifies discoid pith as: (1) Heterogeneous continuous diaphragmatic, when the pith is continuous between the disks, and (2) heterogeneous discontinuous diaphragmatic, when the pith is not continuous between the disks, but the interspaces filled with air. The first type of pith is found in *Liriodendron, Magnolia* species, *Asimina, Nyssa,* etc., and the cells forming the disks are very thick-walled and heavily lignified, while the cells forming the interspaces are small, very thin-walled and empty. The second type is found in *Juglans, Pterocarya, Celtis, Halesia, Forsythia viridissima, Jasminum* species, *Paulownia,* etc., and the cells forming the disks are thin-walled, empty and often shrunken. Discoid pith seems to be of taxonomic importance for generic distinctions in some

cases; though the characters it furnishes may be of only specific rank, as in *Forsythia* and *Jasminum*.

A Plea for the Preservation of Our Wild Flowers: C. E. Bessey and S. Coulter.

Cultivated flowers are planted and cared for by man, but no one cares for the wild beauties of the woods and meadow. We must preserve them. It is our privilege as lovers of plants to care for them and to see that they are not exterminated. The rarer the plant the greater the danger that it will be eradicated. Who are the offenders? The tourists, who lay their vandal hands on everything pretty; the amateurs, who desire to have samples of everything; and some botanists who think more of collecting specimens than of the beauties of nature in the field. At Colorado Springs the once beautiful Cheyenne Canyon has been made barren by the vandals, and there is scarcely a fern or a pretty flower now left in it. What shall we do about it? First of all let us talk vigorously against this vandalism. Talk in season and out of season, and denounce the wholesale destruction of wild flowers in the strongest language possible. Then write against vandalism. Do not fail to say what you think through the public press. The newspapers will help you every time if you call upon them. Then organize clubs and guilds and societies. Do this as you please. If you prefer to form a local chapter of the Wild Flower Preservation Society well and good. We shall take great pleasure in helping you. But if you prefer to form an independent club—do so by all means. It is not how you do it; it is only that you do something. Agitate the matter persistently and vigorously, and keep at it. In this way, only, may we hope to save our attractive wild flowers from extinction.

Type of the Genus Agrostis: A. S. Hitchcock.

In view of the fact that stable generic nomenclature depends upon the method of fixing the type of each genus, investigations concerning the effect of various rules upon different genera must be carefully worked out. For this reason the history of the grass genus *Agrostis* is presented. The effect of the application of different rules will be shown.

The Morphology of Elodea Canadensis: R. B. Wylie.

The pistillate flower is strongly epigynous, the fused parts of the flower forming a long floral tube which extends from the sessile ovary to the surface of the water. The stamens each bear two sporangia and the staminate flowers at maturity break loose from the stem and rise to the surface of the water. The rise of these flowers is aided by bubbles of oxygen. Though the pollen grains are heavier than water, the multitudes of spines on the exine hold back the surface film, thus imprisoning enough air to keep the spores afloat. The male cells, which are formed in the pollen grains, are very large, and during their continuance in the spores remain joined together. The pistillate flower opens upon reaching the surface of the water and the stigmas soon recurve, arching out over the floral parts. Since the stigmas are impervious to water, the weight of the flower resting on them forms a depression in the surface film. Pollen grains floating near are now attracted to the flower by gravity, operating through the declined surface film. They approach and drop into this depression in contact with the stigmas. In the development of the embryo-sac, four megaspores are usually formed, though six were noted in one instance. The embryo-sac at the two-celled stage develops an antipodal pouch, in which the antipodal group of nuclei is formed. The pollen tube shows a marked development. Its

course is down the floral tube, thence directly through the ovarian cavity to the upturned micropyles of the ovules. The pollen tubes that have failed to enter ovules often swell up at their tips into tuber-like enlargements, which may be fifteen times the normal diameter of the tube. In these tubers which lie among the ovules, the male elements can be made out, each distinctly a cell, rather than a nucleus only. About each male nucleus, which usually shows a nucleolus, is an ample cytoplasm bounded by a membrane. The functioning pollen tubes pass through the micropyle and seem to enter one of the synergids. Numerous preparations showed one sperm in contact with the egg nucleus, and in several instances the second sperm was found fusing with the endosperm nucleus. The egg regularly divides before the primary endosperm nucleus. The functioning pollen tubes persist for a long time, sometimes until the embryo is well developed.

Prothallia of Botrychium obliquum: H. L. LYON.

During the summer of 1903 gametophytes of *Botrychium obliquum* were collected in considerable numbers in Minnesota. In shape they resemble those of *B. Virginianum* but average only about one third the size of the latter. The reproductive organs are borne dorsally and do not differ essentially from those of other Ophioglossaceæ described. The embryo sporophyte is bipolar instead of tripolar as in *B. Virginianum,* the stem growing directly upward and the root directly downward through the prothallium. There is no pronounced nursing-organ. All the superficial cells of that portion of the embryo lying within the tissue of the gametophyte apparently act as absorbent cells. The primary root usually protrudes 1 to 3 cm. from the prothallium before the first leaf bursts through the calyptra.

The Life History of Ephedra trifurca: W. J. G. LAND.

Material for a morphological study of *Ephedra trifurca* was obtained in the vicinity of Mesilla, N. M. Collections were made at regular intervals between December 20, 1902, and May 20, 1903. The primordium which gives rise to the staminate flowers was apparent in the first material collected. The perianth appeared a month later. The primary wall cell divides to form two layers, the wall cell and the tapetum. The microspore mother cells remain in the resting condition about one month. The reduction division occurs about March 15. The gametophyte number of chromosomes is twelve. The male gametophyte at the time of the shedding of the pollen grain consists of two prothallial cells, tube nucleus, stalk cell and body cell. The body cell divides shortly before fertilization occurs. The ovule has two integuments: an outer one resulting from the fusion of four bracts, the inner one from the fusion of two bracts. The megaspore mother cell appears about March 8. Sometimes two or three megaspore mother cells are present, but only one megaspore functions. As the result of the division of the megaspore mother cell a row of four or sometimes three megaspores is formed, the lowest one being of course functional. The division of the megaspore is followed by free nuclear division and parietal placing. At least 256 nuclei are formed before walls appear. One, two or three archegonia are formed, and the central cell is placed deeply in the tissues of the gametophyte. The ventral nucleus is cut off shortly before fertilization, which occurred the present year about April 20. The oospore forms from two to eight free nuclei, each one of which organizes a wall and gives

rise to an embryo. The normal number of free nuclei is in general four. The single suspensors are very long and thrust the embryos deeply into the endosperm. Only one of the embryos develops.

The Effect of Chemical Irritation upon the Respiration of Fungi: Ada Watterson.

These experiments concerning the effect of chemical irritation upon the respiration of fungi were carried on with the Kunstmann and with the Pettenkofer forms of apparatus. The fungi used were *Sterigmatocystis nigra* and *Penicillium glaucum,* and the irritants were $ZnSO_4$, $FeSO_4$ and LiCl. The results go to show that although the economic coefficient of the sugar is increased, yet the CO_2 respired by the fungus remains proportionally the same.

The Dehiscence of Anthers by Apical Pores: J. A. Harris.

The author presents a systematically arranged descriptive list of all genera in which the dehiscence of the anthers is by apical pores, and makes a series of comparisons of the floral structure of these forms with other members of the same family, showing the modifications in not only the stamens, but the other floral parts as well, upon the assumption of the apically dehiscent habit. The forms are divided into groups or 'types' on structural grounds and the ecological relations of these considered. While the types as a whole are not sharply limited, a pronounced similarity of form in the corresponding parts of the different genera is observable even when these belong to systematic groups differing widely in floral habit. For some of these types the geographical distribution of the genera and species has a similarity which does not seem to depend on systematic relationships. The only explanation which seems possible is that of the somewhat similar distribution of the Apidæ, upon which their structure indicates they are largely dependent for pollination.

Francis E. Lloyd,
Secretary.

GEOGRAPHY IN THE UNITED STATES. II.

It has been maintained that one of the embarrassments from which geography suffers is the incoherence of the many things that are involved in its broad relationships. This is not really a serious embarrassment, and so far as it is an embarrassment at all it is not peculiar to geography. It is not a serious embarrassment, because when any element of geography is treated in view of the relations into which it enters, it becomes reasonably interesting to all who are concerned with scientific geography. The embarrassment is not peculiar to geography, for it is found in all other studies; in history, for example, where an essay by a specialist on the modern history of South America is not likely to excite an enthusiastic interest in the mind of the student of classic times in Greece, or in the mind of the student of medieval church history in Germany; the embarrassment is known also in geology, where the student of the petrography of the southern Appalachians, or of the paleontology of the Trias in California, may care little for a paper by a colleague on the glaciation of the Tian Shan Mountains in Turkestan. Yet, however unlike these various topics in history or in geology may be, they are welcomed, if well treated, by all the members of the expert society or by all the readers of the special journal in which they are presented, because they so manifestly make for progress in the science to which they belong. Geographers need not, therefore, be embarrassed on finding discussions of magnetic declination as affecting the navigation of the antarctic re-

gions, of the relations of climate and religion among the Hopi amerinds, and of the facilities for irrigation peculiar to aggrading fluviatile plains, all in one journal; this diversity of topics only illustrates the great richness of geography, and thus likens it to history and geology.

Let me consider next the advantages that will come to geography from the systematic collection and classification of all the facts pertinent to it. The popular idea of geographical research is fulfilled when an explorer discovers a new mountain or a new island; but discovery is not enough. The thing discovered must be carefully described in view of all that is known of similar things, and the relation into which the thing enters must be sought and analyzed. Careful work of this nature involves the development of systematic geography, in which all items of a kind are brought together, and all kinds of items are arranged according to some serviceable scheme of classification. Geographers are far behind zoologists and botanists in this respect, for there is to-day no comprehensive scheme of geographical classification in general use. Existing schemes are too generally empirical and incomplete. So important a group of land forms as mountains has never yet been thoroughly treated in a physiographic sense, while the organic responses to inorganic controls are as a rule not classified by geographers at all; yet a comprehensive scheme of classification should certainly provide systematic places for the organic responses as carefully as for inorganic controls. In the absence of a generally accepted scheme of classification, it is natural that items of one kind and another should be neglected in text-books and elsewhere; for it is well known that incompleteness of treatment goes with unsystematic methods. So simple and manifest a response to the globular form of the earth as is afforded by a wide extent of modern commerce is seldom mentioned in connection with its control. The many important and interesting responses to the eternal and omnipresent force of gravity are not habitually treated as geographical topics at all; nor is the definition of boundaries in terms of meridians and parallels usually recognized as a response that civilized nations now habitually make to the form and rotation of the earth, when they have occasion to divide new territory in advance of surveys and settlement. Yet surely all these responses to environment deserve systematic mention when the earth is described as a rotating, gravitating globe, just as the location of villages and the growth of cities at some point of advantage to their inhabitants deserve mention in the pages given up to geography of the more conventional kind. The development of a well-tested scheme of systematic geography may, therefore, be urged upon every geographer as a problem well worthy of his attention. A practical step toward the construction of such a scheme is evidently the accumulation of items that call for classification; therefore, let the geographer study the world about him: and a most effectual aid in the accumulation of items is found in searching for the organic response to every inorganic control, and for the inorganic control of every organic response that comes to one's attention; therefore, let the geographer think carefully as he looks about him over the world. It can hardly be doubted that the explorer who goes abroad or the student who stays at home will make better progress in his investigations in proportion to the completeness of the systematic scheme with respect to which he consciously carries on his work. I would, therefore, urge the development of the habits of always associating causes with their consequences and consequences with their causes, and of always referring both

causes and consequences to the classes in which they belong. If to these two habits we add a third, namely, that of making a careful arrangement of the classes in a reasonable and serviceable order, we shall have taken three important steps in geographical progress, and, as a result, geography will flourish.

There is no device by which the work of the specialist is so helpfully relieved of its narrowing influence as by the simple device of looking always for the general geographical relations of any special topic. The specialist in the geographical study of ocean currents, of caverns or of deltas, of forests, of trade routes or of cities, should not lessen his attention to his chosen line of work, but he should, often to his great advantage, increase his attention to the place that his chosen subject holds in the whole content of geography. Not only will his work be broadened in this way, but both he and his work will be brought into closer relations with the whole body of geographers and the whole content of geography, and the possibility of organizing a society of mature geographical experts will be thereby greatly increased. If the geographical relations of a special topic are not looked for, the specialist fails to that extent of becoming a geographer. The climatologist who studies the physical conditions of the atmosphere for their own sake, the oceanographer who makes no application of the physical features of the ocean as controls of organic consequences, the geomorphist who is satisfied with the study of land forms as a finality, the student of the location of cities and the boundaries of states who makes no search for the explanation of his facts as affected by physiographic controls—these specialists may all be eminent in their own lines, but they fall short of being geographers. In the same way it might be shown that a petrographer who makes no study of field relations and discovers no results of processes and no sequences in time, fails of being a geologist, for geology deals essentially with processes and structures in time sequence; likewise a chronologist who is satisfied with mere dates of occurrence fails of being a historian, for history involves the meaning as well as the mere sequence of human events. There is, of course, no blame to be attached to interest in specialization, no praise to an interest in larger relations; it is merely a matter of fact that the isolated specialist remains somewhat to one side of the larger sciences with which he might become associated. On the other hand, the geographer is not necessarily so broad-minded that he must be shallow; he may specialize deeply on the climatologic, oceanographic, geomorphic, topographic, organic divisions of his subject; but if he wishes to be considered a geographer he should cultivate all the geographic relations into which the facts of his chosen division enters, and he will find that it is largely through these relations that he associates himself profitably with other geographers.

Two of the most beneficial results of the systematic study of geography are the great increase in the number of classes or types with which the geographer becomes familiar, and the great improvement in the definition of these types. This is particularly the case with those types which contain many individual examples, such as rivers and cities, and which are, therefore, capable of division into many headings. So long as the geographer deals only with things in an empirical fashion, he may be satisfied with a rough classification; as soon as he begins to treat his problems more carefully, his classification becomes more refined and he has relatively more to do with classes of things than with the things themselves. The things are actual, the classes are ideal, and therein lies one

of the greatest values of systematic geography; it enforces attention upon the idealized type; by means of this increased attention the type is more fully conceived, and both observation and description of actual things are greatly aided. Let me illustrate.

The breezes that descend from mountain valleys at night are well known and well understood phenomena. As a result, one may form a well-defined conception of such a breeze—a type mountain breeze—imagining its gradual beginning, its increase in strength with its extension in area, and its gradual extinction; all its phases of waxing and waning being duly related to the passing hours of the night and to the associated changes of temperature. It is safe to say that no actual mountain breeze is as well known by direct observation of all its parts and stages as is the type breeze, in which all pertinent observations are properly generalized, and in which the deficiencies of observation are supplemented as far as possible by inferences deduced from well-established physical laws. It is entirely possible that there may be some errors in the deduced elements of the ideal type-breeze, but it may be confidently asserted that the errors will be replaced by the truth through the methods involved in observing, imagining and checking, guided by the conception of the type, sooner than the truth will be discovered by blind observation unguided by the aid that a well-defined type affords.

It is the same with an alluvial fan; an element of land form that has, by the way, more similarity to a mountain breeze than appears on first thought. Observation shows only the existing stage of the surface of a fan; the fully developed type-fan includes the structure as well as the surface, the process and the progress of formation, extended into the future as well as brought forward from the past. There can be no question that the explorer who is equipped with a clear conception of a type-fan can do much better work in observing and describing the fans that he may find than will be done by an explorer who thinks he can dispense with all idealized types, and who proposes simply to describe what he sees. The shortcomings of the simple observational method would be less if it were not so difficult to see what one looks at and to record what one sees; but any one who has had experience in field studies knows how far short seeing may be of looking, and how far short recording may be of seeing. The best results in geographical investigation can only be obtained when every legitimate aid to observation and description is summoned; and of all aids, that furnished by carefully considered types, reasonably classified, is the greatest. When large and complicated features, such as valley systems or cuestas, are to be described, the need of types is vastly increased. Hence one of the most important and practical suggestions that can be made toward the maturing of geographical science is to cultivate the geographical imagination in the direction of acquiring familiarity with a large, systematic series of well-defined ideal types. As progress is made in this direction there will be profitable advance from that narrow conception of geography which is based on the school-day study of names, locations and boundaries—the only conception of geography that many mature persons in this country possess—to a wider conception in which everything studied is considered as an example of a kind of things, so that it shall appeal to the reasonable understanding rather than to the empirical memory. Progress of this sort is already apparent in the schools, but it has not yet reached a desirable measure of advance.

One of the best results that follow from the systematic recognition of a large num-

ber of well-defined types will be the natural development of an adequate geographical terminology. When review is made of modern geographical articles it is curious and significant to find only a small addition to the school-boy list of technical terms. This is not true of any subject that is cultivated in the universities as well as in the schools. It is a reproach to geography that the results of mature observation are so generally described in the inadequate terms of immature study; this reproach will have the less ground the more thoroughly systematic geography is studied. With the development of more mature methods of description there may come a larger share of attention to the thing described, and thus a relative decrease of attention to matters of merely personal narrative. I do not wish to lessen the number of entertaining books of travel which now fill many of the shelves in libraries called geographical, but it would be a great satisfaction to see the standard works of geographical libraries given a more objective quality, so that they might compare favorably with the standard works of geological or botanical libraries, in which the element of personal narrative is reduced to its properly subordinate place.

Another step of equal importance with the establishment of geographical types is the change from the empirical to the explanatory or rational or genetic method of treating the elemental facts that enter into geographical relationships. The rational method has long been pursued in regard to the facts of the atmosphere and the ocean; it is coming to be adopted for facts concerning the lands; and since the adoption of an evolutionary philosophy, the evolutionary explanation of the organic items of geography may replace the teleological treatment that obtained in Ritter's time. It is, however, very seldom the case that geographers adopt the rational method consciously and fully; hence special attention to this phase of the theoretical side of geography may be strongly urged. It may be noted in this connection that the application of the explanatory method has been so lately made to the treatment of land forms that the geographer may for the present make himself to his advantage something of a specialist in this branch of the subject. It should be added that, so long as he studies land forms in order better to understand the environment in which living things find themselves, he remains a geographer and does not become a geologist. There is a needless confusion in this matter, which may, perhaps, be lessened if its untangling be illustrated by the following geological comparison.

For some decades past a new method of treatment has been applied to the study of rocks, greatly to the advantage of geologists. The method requires a good knowledge of inorganic chemistry and of optical physics, and the geologists who have specialized in the study of rocks have had to make themselves experts in these phases of physics and chemistry; but they are not for that reason classified as physicists or chemists. They remain geologists, though sometimes taking the special title of petrographer. So with the geographer who specializes in the study of land forms; he must make himself familiar with certain phases of geology, but he does not, therefore, become a geologist; he remains a geographer. His object is not to discover for their own sake the past stages through which existing land forms have been developed; he studies past forms only in order to extend his knowledge of systematic physiography and thus to increase his appreciation of existing forms. As far as he studies the sequence of past forms he is studying a phase of geology, just as the geologist who examines existing arrangements of climate, of oceanic circulation, or

of land forms, is studying a phase of physiography. The two sciences are manifestly related, but they need not be confused. For, as has been shown for sciences in general, geology and geography are best characterized by the relations in which their topics are studied, and not by the topics themselves. Both are concerned with the earth and life. The whole content of knowledge concerning the earth and life might be shown by a cube, in which vertical lines represented the passage of time, and horizontal planes represented phenomena considered in their areal extension; then if the whole mass of the cube were conceived as made up of vertical lines, that would suggest the geological conception of the whole problem; while if the cube were made up of horizontal planes, that would suggest its geographical aspect; and the whole series of paleogeographies, horizontally stratified with respect to the vertical time line, would culminate in the geography of to-day.

Objection is sometimes made to the plan of geography, as here set forth, that it involves hypotheses and theories, instead of being content with matters of fact, as the advocates of a more conservative method in geography suppose themselves to be. There is no doubt that geographical investigation of the kind here exposed does involve abundant theorizing, but that is one of its chief merits, for therein it adopts the methods of all inductive sciences. Furthermore, as between the progressive geographer, who candidly recognizes that he must theorize, and the conservative geographer, who thinks that he observes facts only and lets theories alone, the chief difference is not that the first one theorizes and the second does not, but that the first one knows when he is theorizing and takes care to separate his facts and his inferences, to theorize logically, to evaluate his results, while the second one theorizes unconsciously and hence uncritically, and, therefore, fails to separate his inferences sharply from his facts, and gives little attention to the evaluation of his results. Geography has, indeed, suffered so long and so seriously from the failure of geographers to cultivate the habit of theorizing as critically as the habit of observing—studies of the atmosphere and the ocean still excepted, as above—that a strong recommendation must be given to the acquisition of the methods of theoretical investigation, in which deduction is an essential part, by every one who proposes to call himself a scientific geographer. Let me give an example of the loss of time that has resulted from the failure of geographers to develop the habit of theorizing.

For forty years past there has been active discussion as to how far land forms in glaciated regions had been shaped by glacial erosion, but not till within five years has any geographer clearly defined the deductive side of this problem. In order to determine whether land forms are carved by glacial erosion or not, two methods have been open: one is to observe the action of existing glaciers and thus determine whether they are competent or not to carve land forms; but this is difficult, because the beds on which glaciers lie can not be well examined. The other method is to deduce the appropriate consequences of both the affirmative and the negative suppositions, and then to confront these consequences with the facts found in regions once glaciated, and see which set of consequences is best supported. This deductive method is very simple. Its application involves no principle that was not perfectly well known fifty years ago, though it does involve a facility in theorizing that does not seem to have been familiar or habitual with geographers until more recent times. On the supposition that gla-

ciers do not erode, the valley systems of once glaciated mountains ought not to exhibit any significant peculiarity of form, but should correspond to the normal stream-worn valley systems of non-glaciated mountains. On the supposition that glaciers do erode, the valley systems of once glaciated mountains should exhibit the highly specialized feature of a discordant junction of branch and trunk; for the channels eroded by a small branch glacier and by a large trunk glacier must stand at discordant levels at their junction, just as the channels of a small stream and a large river do, though the measure of discordance is much greater in the channels of the clumsy, slow-moving ice-streams than in the channels of the nimble, quick-moving water-streams. There can be no question that these well-specialized consequences, deduced from the postulate that glaciers can erode their channels, are much more accordant with the actual features of valley systems in once glaciated mountains than are the consequences deduced from the opposite postulate; but my reason for introducing this problem here is not to call attention to the value of 'hanging valleys' in evidence of glacial erosion, as first clearly set forth by Gannett in 1898 in his account of Lake Chelan, but rather to point out how slow geographers have been to employ the deductive method in solving this long-vexed problem. The moral of this is that geographers as well as geologists, physicists, astronomers, ought to have good training in scientific methods of investigation, in which all their faculties are employed in striving to reach the goal of full understanding, instead of depending so largely on the single faculty of observation.

Some may, however, object that the problem of glacial erosion, just touched upon, belongs exclusively to geology, and not at all to geography. It belongs to both; its association will be determined by its application, as the following considerations will show. The accumulation of sand-dunes by wind action, the abrasion of sea-coasts by waves, the erosion of gorges by streams, the construction of volcanoes by eruptions now in progress, manifestly belong in the study of physical geography, in close association with the blowing of the winds, the rolling of the waves, the flowing of streams, and the outbursting of lavas and gases. Both the agent and the result of its action are elements of the environment by which life is conditioned. Similarly, the grass-covered dunes of Hungary, the elevated sea-cliffs of Scotland, the abandoned gorges of central New York, and the quiescent volcanoes of central France, are all elements of land forms and are all treated as geographical topics and explained by reference to their extinct causes in the modern rational method of geographical study. Likewise the discordant valley systems of glaciated mountains are proper subjects for explanatory treatment in the study of geography, although the glacier systems that eroded them are extinct; they deserve explanatory treatment in geography just as fully as do the accordant valley systems of non-glaciated mountains. It is true that discussion as to whether certain sculptured land forms are due to glacial erosion is likely to continue more or less actively through the present decade; but when this problem is as well settled as the problem of stream erosion has already been, the geographer will be content with the simplest statement of the evidence that is essential to the conclusion reached; and the explanatory descriptions of land forms will include due reference to forms of glacial origin, just as much as a matter of course as they now include reference to forms of marine or of subaerial origin. Forms of glacial sculpture will be given as assured a place in

geographical study as forms of glacial deposition are already given. Neither the thing studied, nor the agent by which it was produced, nor the method by which the agent is shown to be accountable for the thing, suffices to show whether the thing is of a geological or a geographical nature. This question will be decided, as has already been shown, by the relations into which the thing enters. It would be as unreasonable to omit all reference to glacial erosion in a geographical description of Norway as to omit all reference to subaerial erosion in a geographical account of our Atlantic coastal plain.

Nowhere is the cultivation of systematic geography more helpful than in the study of local or regional geography. The truth of this may be appreciated by considering the case of botany. No botanist would attempt to describe the flora of one of our states until he had obtained a good knowledge of systematic botany in general. Such knowledge would help him at every turn in his study of a local flora, not only in describing the plants that he might find, and in arranging the descriptions in a serviceable order, but also in finding the plants themselves. I believe that a closely equivalent statement might be made with regard to the geography of a state; and yet there is not, to my knowledge, a single work on regional geography in which a recognized scheme of systematic geography has been avowedly followed as a guide for the treatment of local features. The adoption of such a guide would lead to various advantages; on announcing that a certain scheme of systematic geography has been chosen as a standard, the writer of a regional work thereby gives notice in the simplest manner to the reader as to the kind and amount of knowledge necessary to understand the work in hand; descriptions are made at once briefer and more intelligible than by phrasing them in terms of a scheme that is elsewhere stated in full; relative completeness of treatment is assured, for with a systematic list of all kinds of geographical relations at hand, the writer is not likely to overlook any element of the subject that occurs within his chosen region; the reader can easily find any desired topic, not only by means of the table of contents and index, but also by means of the standard scheme of classification in accordance with which all elements are arranged; and finally, books on different regions will come to exhibit a desirable uniformity of treatment when they are based on a common scheme of systematic geography. Although no books of this kind now exist, I do not think it overventuresome to say that some such books will soon exist, and that they will form very serviceable contributions to the literature of our subject.

The various recommendations that I have made are likely to remain in the air, or at most to secure response only from isolated individual students, unless those who believe that the adoption of these recommendations would promote the scientific study of geography are willing to give something of their time and thought toward organizing a society of geographical experts—an American geographers' union. From such a union I am sure that geography would gain strength, but it is not yet at all clear in my mind that any significant number of persons would care to accept the strict conditions or organization which appears to me essential for the success of such an enterprise. The most important of the conditions are as follows:

1. The adoption of some definition for geography that shall sufficiently indicate the boundaries as well as the content of this broad subject.

2. The limitation of membership to persons with whom geography as thus defined is a first or at least a second interest, and

by whom more than one geographical article of advanced grade, based on original observation and study, has been published.

3. The independence of the union thus constituted of all other geographical societies.

Although we can not adduce any existing geographical society in this country as a witness competent to prove that geography has sufficient unity and coherence to tempt geographers to form such a union as is here contemplated, a careful review of the problem convinces me that a sufficient unity and coherence really exist in the science as I have treated it; and I, therefore, believe that the formation of an American geographers' union is feasible as well as desirable.

It has been my object in this address to describe briefly the status of mature geography in our country, and to suggest several steps that might be taken for its improvement. Certain branches of the subject have reached a high development, but the subject as a whole does not thrive with us. The reason for its relative failure is not, I believe, to be found in the very varied nature of its different parts, but rather in the failure to place sufficient emphasis on those relationships by which, more than by anything else, geography is to be distinguished from other sciences, and by which, more than by anything else, geographers may come to be united. Among the great number of persons—many thousands in all—whose attention is given primarily to subjects that are closely related to geography as here defined, there must certainly be many—probably several hundred—with whom mature geography is a first interest. It is upon these persons, geographers by first intention, that the future development of sound and thorough, mature and scientific, geography among us primarily depends. To these geographers, in particular, I would urge the importance of developing the systematic aspects of the science, and of constantly associating the special branch that they cultivate with the subject as a whole. Observation will not suffice for the full development of geography; critical methods of investigation, in which deduction has a large place, must be employed; for only by the aid of careful theorizing can an understanding of many parts of the subject be gained. With the progress of systematic geography we may expect to see a parallel progress of local or regional geography. As the science is thus developed, societies of mature geographical experts will be formed, and scientific geography will thrive; but whether thus developed into a thriving science or not, I hope that another long term of years may not pass without a representative of geography in this vice-presidential chair.

W. M. Davis.

Harvard University.

KARL ALFRED VON ZITTEL.

In the death of Karl Alfred von Zittel paleontology has lost one of its most distinguished advocates. Although a German by birth, Professor von Zittel belonged to every country, and through his remarkable work 'Handbuch der Palæontologie' his influence extended everywhere. It is probably not an exaggeration to say that he did more for the promotion and diffusion of paleontology than any other single man who lived during the nineteenth century. While not gifted with genius, he possessed extraordinary judgment, critical capacity and untiring industry.

The first volume of his great work bears the date 1876–1880, covering the extinct Protozoa, Cœlenterata, Echinodermata and Molluscoidea; the second volume, covering the Mollusca and Arthropoda, bears the date 1881–1885; the third volume, beginning the Vertebrata, was issued between 1887 and 1890, and covers the Pisces, Am-

phibia, Reptilia and Aves; the fourth volume, issued between 1891–1893, is devoted to the fossil mammalia. Under his editorship appeared also the second part of the great 'Handbuch,' including the 'Palæophytologie' begun by Schimper and continued and concluded by Schenk, and issued in 1890.

These volumes, which together number 4,315 pages, are richly illustrated and admirably indexed, and constitute a veritable encyclopedia of paleontology.

Immediately after the completion of this work the author began the preparation of a condensed treatise upon the whole subject, entitled 'Grundzüge der Palæontologie,' which was issued in 1895, consisting of 950 pages. A second revised edition has just appeared (1903).

We mention this monumental work first, because it was chiefly through this that the influence of von Zittel was exerted. The prodigious progress of paleontology in the nineteenth century was scattered through thousands of monographs and special papers, a hopeless labyrinth to the student, and an extremely difficult field even to the expert investigator; it had ceased to be possible to gain a perspective view of the whole subject, not to speak of the difficulty of mastering the details. With remarkable clearness and fullness, with impartial justice to workers in every country, with especially warm appreciation of the work done in America, von Zittel devoted himself for twenty years to this great task. I had the privilege of studying with him in Munich while he was engaged on the volume on the mammalia, and I was greatly struck with his extremely effective and comprehensive methods of work, which he carried on while giving a full and delightful course of lectures on the same subject.

This, however, was only one form in which von Zittel's influence was exerted. He established a great historical collection in the Alte Akademie of Munich, in which he gathered from all parts of the world collections illustrating the evolution of plants and of invertebrate and vertebrate animals. Here are to be found not only fossils from all parts of Germany, but rare collections from Pikermi and Samos, from the French Tertiaries, especially the phosphorites, from North America, including especially a remarkable collection of Cretaceous fossils made for him by Charles H. Sternberg, as well as a valuable collection of Permian fossils made by Dr. Broili, Mr. Sternberg and others. In addition to these there are remarkably fine specimens secured by exchange and purchase from the Tertiaries of North America, from the Oligocene. The same clear judgment which was displayed in the 'Palæontologie' is evidenced in the arrangement of this vast collection, so that nowhere else in the world can a student follow with equal ease the whole story of the evolution of life.

It is small wonder that Munich became the Mecca of paleontologists, young and old. Professor von Zittel had an exceptionally charming and magnetic personality. His face was full of keen intelligence and enthusiasm. He took the deepest interest in the original researches of young men who came to him from various parts of the world, and was unusually generous in placing in their hands much of his rarest material; in fact, the memoirs which were published under his supervision far outnumber those which he was able to publish himself, because of his long-continued devotion to his preparation of the 'Handbuch.' He occupied a position in paleontology similar to that occupied by the lamented Gegenbaur in comparative anatomy. Among his pupils may be numbered, with a few exceptions, all the younger American, most of the German, and many of the younger French and Austrian paleontologists. All bear him in

most grateful remembrance and will sadly mourn his loss.

The following details of his life are taken from one of the newspaper notices of his death. He was a son of Karl Zittel, the leader of the Clerical Liberals in Baden, and was born at Bahlingen, near Freiburg, on September 25, 1839. He studied at Heidelberg, Paris and Vienna. After serving as assistant in the Hofmineralien-Kabinet in Vienna, he was appointed professor of mineralogy at Karlsruhe, and in 1866 he assumed the same professorship in Munich, where he also became director of the Paleontological Staatsmuseum. The great scientific value of the Rohlf expedition to the Libyan desert in 1873–74 was owing chiefly to his participation in it. He wrote a book on the expedition; another on the Sahara, and many treatises on geological and paleontological subjects. In 1899 he published his 'Geschichte der Geologie und Palæontologie'—an important work carrying the subjects to the end of the nineteenth century. He was editor of the periodical *Palæontographica*. He was present at the opening of the Northern Pacific Railroad in August and September, 1883. It may be added that he had been in delicate health for some years. His death was unfortunately hastened by his being struck by a bicyclist, causing a serious injury to his knee and a long and debilitating confinement.

He traveled extensively. Aside from the special journey to the United States in connection with the Northern Pacific Railroad, he came here again in connection with the meeting of the International Geological Congress, visiting all the American museums and studying the great collections with most intense interest. At the meeting of the Geological Congress in Paris in 1900, Professor von Zittel received the honors to which he was so richly entitled, frequently presiding over the paleontological and geological sections.

Henry Fairfield Osborn.

SCIENTIFIC BOOKS.

The Moth Book. A Popular Guide to a Knowledge of the Moths of North America. By W. J. Holland. New York, Doubleday, Page & Company, 1903. Pp. xxiv + 479. Forty-eight plates in color photography and numerous illustrations in the text.

All persons interested in the study of Lepidoptera, including hundreds of amateur collectors, have anxiously been awaiting the publication of Dr. Holland's 'Moth Book,' which was promised five years ago in the introduction to his well-known and very useful 'Butterfly Book.' The volume has now appeared, and will be a delight to collectors and will greatly facilitate their attempts to determine their specimens, and will no doubt induce many others to take up the study of these beautiful and interesting insects. In his 'Butterfly Book' Dr. Holland had a restricted group of comparatively few species, and was able to illustrate or describe practically every species known to occur within the limits of the United States. The task of producing a serviceable moth book has been much more difficult. To illustrate and describe all of the thousands of species of moths of this country would require the publication of several volumes. Therefore, an effort has been made to select those species which adequately represent the various families and the commoner and more important genera, thus providing a work which will serve as an introduction to the study. The selection has been admirable. The 48 colored plates illustrate with beautiful accuracy more than 1,500 species, and all through the text are illustrated other species to the number of more than 250. Dr. Holland adopts in the main the classification of Sir George Hampson, and uses 43 family names. In nomenclature he wisely follows, for the most part, Dr. Dyar's list of the Lepidoptera of the United States, and has conformed the text of his volume to Dr. Dyar's serial arrangement. Dr. Holland differs, as he says, from Dr. Dyar

in his views as to the position which should be held in relation to each other of a number of genera, but as Dyar's list is certain for many years to come to be used largely by American students in arranging their collections, he has thought best to follow it. As in the 'Butterfly Book,' the 'Moth Book' contains a number of digressions and quotations. The quotations are extremely apt, and the digressions are extremely readable.

Dr. Holland's literary style is charming, and his cosmopolitan training and wide range of information lend interest and value to every line of the digressions. The one entitled 'Walking as a Fine Art' deserves a place in literature as well as in a treatise on hygiene. The book is by no means confined to descriptive matter of the species treated. Statements concerning the habits and the life histories are scattered through the pages, and much sound information of a practical economic character accompanies the accounts of many of the injurious species. The general chapters on the life history and anatomy of moths, and on the capture, preparation and preservation of specimens, contain all the information that is necessary, and in the chapter entitled 'Books about the Moths of North America' the author has given a competent bibliography for the use of students who wish to go further into the subject. The index is very full.

As a bit of book-making, the volume is a handsome one. Some of the text figures suffer in the printing on account of the character of the paper used, but this is by no means a serious blemish.

Dr. Holland is to be congratulated on the completion of this very attractive and useful work, and the number of collectors and students is sure to be increased rapidly as the result of its publication. L. O. HOWARD.

Allgemeine Physiologie. Ein Grundriss der Lehre vom Leben. By MAX VERWORN. Fourth Edition, revised. Jena, G. Fischer. 1903. Pp. 652; illustrations 300.

The favor with which this work is still regarded is evinced by the fact that the fourth edition is now called for within nine years of the book's first appearance. The author has made in it less radical changes than in previous editions. Those portions which have received the most considerable alterations are the section on 'Physical World and Mind,' which has been rewritten and enlarged, and endeavors to present more clearly than before the author's psychomonistic conception; the section on 'Enzymes and Their Mode of Action,' which has again been rewritten, largely for the purpose of showing the analogy between ferment actions and the catalytic actions of inorganic chemistry; and the section on 'Growth as the Fundamental Phenomenon of Change of Form,' which has been revised and extended by Professor Rhumbler, and contains the latest conclusions of that well-known investigator, with figures and discussions of Rhumbler's and Heidenhain's models of the dividing cell. In the revision of the chemical portions of the book the author has had the counsel of Professor von Baeyer, of Munich, and Dr. Coehn, of Göttingen, and the alterations, though not great, represent improvements.

Engelmann's law of complementary chromatic adaptation is cited, according to which the color of an organism becomes more and more complementary to that of colored light to which the organism is subjected. Macfadyen's observations are summarized on the resistance of bacteria to extreme cold, and Regnard's observations of the temporary cessation of vital activity in a large variety of organisms subjected for not too long a time to great pressure. Wallengren's demonstrations are quoted of anodic, kathodic and transverse galvanotaxis in the same organism by the application, to the same spot, of polar stimuli of different intensities. Many other recent discoveries are cited; but with the multiplicity of present investigations in general physiology one naturally finds many important omissions. By judicious excisions and condensations of the previous text the enlargement of the book, caused by the additions and a much-needed revision of the index, is limited to twenty-one pages.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Infectious Diseases, Volume I., No. 1.

FREDERICK G. NOVY and WARD J. MCNEAL: 'On the Cultivation of *Trypanosoma Brucei*.'

LOUIS B. WILSON and WILLIAM M. CHOWNING: "Studies in *Pyroplasmosis Hominis* ('Spotted Fever' or 'Tick Fever' of the Rocky Mountains)."

JOHN R. MCDILL and WILLIAM B. WHERRY: 'A Report on Two Cases of a Peculiar Form of Hand Infection due to an Organism Resembling the Koch-Weeks Bacillus.'

H. GIDEON WELLS and LEE O. SCOTT: "The Pathological Anatomy of 'Paratyphoid Fever.'"

GEORGE H. WEAVER: 'Agglutination of Streptococci, Especially Those Cultivated from Cases of Scarlatina, by Human Sera.'

GUSTAV F. RUEDIGER: 'The Effects on Streptococci of Sera of Cold-blooded Animals.'

WILFRED H. MANWARING: 'The Action of Certain Salts on the Complement in Immune Serum.'

MILTON M. PORTIS: 'Experimental Study of Thyrotoxic Serum.'

ALFRED SCOTT WARTHIN and DAVID MURRAY COWIE: 'A Contribution to the Casuistry of Placental and Congenital Tuberculosis.'

C.-E. A. WINSLOW and D. M. BELCHER: 'Changes in the Bacterial Flora of Sewage During Storage.'

S. C. PRESCOTT and S. K. BAKER: 'On Some Cultural Relations and Antagonisms of Bacillus Coli and Houston's Sewage Streptococci; with a Method for the Detection and Separation of These Microorganisms in Polluted Waters.'

THE opening (January) number of volume 5 of the *Transactions of the American Mathematical Society* contains the following papers:

L. E. DICKSON: 'The Subgroups of Order a Power of 2 of the Simple Quinary Orthogonal Group in the Galois Field of order $p^n \equiv 8l \pm 3$.'

J. G. HUN: 'On Certain Invariants of two Triangles.'

EDWARD KASNER: 'Isothermal Systems of Geodesics.'

A. LOEWY: 'Zur Gruppentheorie mit Anwendungen auf die Theorie der linearen homogenen Differentialgleichungen.'

J. W. YOUNG: 'On the Group of the Sign $(0, 3; 2, 4, \infty)$ and the Functions belonging to it.'

SAUL EPSTEEN: 'On the Definition of Reducible Hypercomplex Number Systems.'

E. GOURSAT: 'A Simple Proof of a Theorem in the Calculus of Variations (Extract from a Letter to Mr. W. F. Osgood).'

The American Naturalist for November is a little belated. It contains the second of the papers on 'Adaptations to Aquatic, Arboreal, Fossorial and Cursorial Habits in Mammals,' this being by Louis I. Dublin on 'Arboreal Adaptations.' In a few instances it would seem that the writer may not have distinguished between physiological adaptation and morphological characters. D. T. MacDougal considers at some length 'Mutation in Plants,' some of his conclusions being that new types of specific rank have arisen in *Œnothera* by discontinuous variation, that natural selection is universally prevalent is certainly disproved and that nothing in the nature of living organisms demands that all species should have originated in the same manner. S. E. Meek presents a paper on the 'Distribution of the Fresh-Water Fishes of Mexico,' considering that four distinct fish faunas are present, and that their origin and number of species are as follows: From the Colorado River, 9; from the Rio Grande, 80; from the Lerma, 49; and from Central America, 246. The final paper, by Pehr Olsson-Seffer, is on the 'Examination of Organic Remains in Postglacial Deposits,' particularly in peat, and contains very good and full directions as to the methods and apparatus necessary.

The Popular Science Monthly for January has for a frontispiece a portrait of the late Herbert Spencer from a bust made when he was seventy-six. The first article is 'A Case of Automatic Drawing,' by William James, with numerous illustrations of the curious pictures made by the subject. In 'The College Course' John J. Stevenson makes a plea for a return to the college with a course of four years, mainly compulsory, and in 'The Functions of Museums' F. A. Bather suggests such a division of the material as would make it most available for the general student, the special student and the general visitor. T. A. Jaggar describes 'The Eruption of Pelé, July 9, 1902'; Allan McLaughlin discusses 'Immigration and the Public Health,' suggesting more carefully drawn laws on the subject, and Amanda Carolyn Northrop considers 'The Successful Women of America,'

being a study of those who appear in 'Who's Who in America.' Authors are in the great majority, and, save in science, those educated in private schools exceed in number those educated in public schools. D. D. Wallace presents the case of 'Southern Agriculture: Its Condition and Needs,' the latter being better trained labor, credit at reasonable rates and a more suitable education for his work. Wm. Scheppegrell describes 'Voice, Song and Speech,' and there is a reprint of Herbert Spencer's 'What Knowledge is of Most Worth?' 'The Progress of Science' contains a criticism of what the Carnegie Institution has not accomplished.

SOCIETIES AND ACADEMIES.

THE ACADEMY OF SCIENCE AND ART OF PITTSBURG. SECTION OF BIOLOGY.

THE regular monthly meeting of the section was held on December 1, in the lecture hall of the Carnegie Institute. Doctor E. G. Matson, city bacteriologist of Pittsburg, discussed with the members, the germ theory and the zymotic theory of epidemic diseases; the discovery of bacteria, their form, structure and office in the economy of nature, evidence upon which rests the doctrine that they are the causes of diseases, the advantages of having the specific agents of these diseases for practical purposes, and at the same time the possibility of getting on without this knowledge; the individuality of contagion and the necessity of taking this into account in the attempt to prevent epidemics, such as smallpox, typhoid fever and yellow fever; how the bacteria make their attack; toxin, antitoxin and the immunity problem.

The malarial mosquito received some attention, and considerable valuable information was given regarding the epidemic of typhoid fever which has been raging for several weeks in Butler, Pa. There have been about 1,800 cases, with 84 deaths, representing a fatality of a little more than 10 per cent.

Many thousands of dollars have been generously contributed from various sources.

The infection of the water supply of the city seems to have been responsible for the general spread of the disease, two cases being discovered not far from the city's reservoir.

FREDERIC S. WEBSTER,
Secretary-Treasurer.

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS.

THE thirty-fourth annual meeting of the Wisconsin Academy of Sciences, Arts and Letters was held in the State Normal School Building in Milwaukee, Tuesday and Wednesday, December 29 and 30, 1903, President J. J. Davis in the chair. The program contained thirty-six titles, nearly every field of science being represented, although physical papers were entirely absent. Several excellent papers were presented upon philosophical, pedagogical and literary subjects. The program was notable in that so many sections of the state and so many different institutions were represented. The number of papers coming from the university, from the colleges and from the normal schools was nearly equal. Volume XIV., part 1, of the *Transactions* of the academy, containing fifteen papers, has just been published.

E. B. SKINNER,
Secretary.

NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE 48th regular meeting of the section was held Friday, December 18, 1903, at 8 P.M., at the Tech Union, Boston, President W. H. Walker in the chair. Sixty members were present.

Dr. Carl Otto Weber, of Manchester, England, addressed the section on the 'Application of Scientific Data to Technical Problems in India Rubber Manufacture,' in which he discussed the various steps in the evolution of a scheme for rubber analysis, and the methods of applying the results to the theoretical and practical consideration of the chemistry of india rubber.

ARTHUR M. COMEY,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CONVOCATION WEEK.

To the Editor of Science: I am in hearty sympathy with nearly all the opinions expressed in the recent article in Science entitled 'Convocation Week.' The American Association has a large membership. One of its chief functions is to provide for its members the means of getting together for scientific and social intercourse. The plan of a convocation week into which might be gathered so far as practicable the numerous scattered meetings of special societies, which were being held without any correlation of time or place, was in my opinion a distinct step in advance.

When the question of winter meetings for the American Association first began to be considered it became evident that many members of the association preferred the summer meeting. Comparatively few probably would attend two meetings a year, but I think it safe to estimate that if by its present plan of holding one meeting a year the association succeeds on the average in securing an attendance of 500 of its 4,000 members, it would, by holding both summer and winter meetings, in localities and at times selected with judgment, have almost if not quite as large an attendance at each. It would thus double its usefulness by supplying the facilities for a scientific meeting to twice as many of its members every year.

The general feeling in the west is for summer meetings. In the east the majority favors meetings in the winter, but the geographical lines are not sharply drawn. Many of us would be glad of a choice between the summer and the winter meeting with privilege of attending one, both or neither at our convenience. The summer meetings should be held, as a rule, in some attractive and accessible resort; in the mountains, on the lakes or at the seashore. By selecting the earliest possible date after the closing of our colleges it would be practicable to house the entire attending membership under one roof. The great summer hotels at the beginning of the season are almost empty and they would welcome the association. The end of the summer, while desirable in certain respects, is the crowded season at such places and it would be difficult to find suitable accommodations.

Summer meetings would probably be as well attended as those held in convocation week; the attendance at the former would indeed be the much larger but for the greater gathering of the affiliated societies in winter.

The association in bringing together men of many sciences has a more important function than appears to be commonly recognized. Without some such organization we shall meet in the various special societies only those who are engaged in our own particular lines of work. The bringing together of the various affiliated societies at a common meeting place helps to mitigate one of the most unfortunate features of modern specialization in science, namely, the separation of men of science into small groups. Moreover, the formation of special societies has gone so far that every one is compelled to hold membership in several. In addition to being a member of the American Physical Society the physicist is or should be interested in the work of the Institute of Electrical Engineers, of the Physical Chemists, of the Society for Astrophysics, of the Mathematical Society, of the Electro-Chemical Society, etc. The affiliation of these and other special societies in the American Association would make it easy for one to get in touch at least once a year with the various activities which they represent, hence the importance of convocation week. It is not less imperative that the American Association afford those of its members who can not attend its winter meetings an opportunity for intercourse with kindred spirits at times and places possible to them. The question of the expense of two meetings a year is not worthy of consideration. It is absurd to say that an association with a membership of 4,000 is unable to carry on two, or if desirable, even more meetings every year.

E. L. Nichols.

When the American Scientific Association was organized in 1847 it was, like its immediate predecessor the Association of American Geologists and Naturalists, the only national society devoted to pure science in

this country. To be elected a member was a certificate of scientific standing. Its first president, William B. Rogers, was equally well known as a physicist and as a geologist, and the day of close specialization had not yet begun. The formation of the National Academy during the civil war was not undertaken with a view to organizing any more select body of investigators, but rather for utilitarian purposes. To be selected as a scientific adviser for the government was a high honor, but it seems not to have interfered with the loyalty of any member to the national association. At the memorable Albany meeting in 1851 about 27 per cent. of the total membership of 769 were present. At the Washington meeting in December, 1902, about 27 per cent. of the total membership of 3,596 were present.

That differentiation should result from increasing growth was naturally to be expected. In 1875 the first division into two sections was made, the total membership being still only 807. It was at the Saratoga meeting in 1879 that the policy of popularizing the association seems to have been inaugurated, the barriers to membership, in the form of recognized scientific credentials, being in great measure removed. The next meeting, held in Boston, was attended by 997 persons, and the total membership was increased to 1,555. At the Cincinnati meeting in 1881, although the attendance was but half that of the Boston meeting, it was decided to break up into nine sections. Already a serious source of embarrassment had sprung into existence in the form of an invasion of cranks. About the same time was noticed the absence of a number of members of the National Academy who had formerly been regular attendants. To guard against the admission of papers by ill-balanced or ignorant persons it was necessary to form committees of inspection whose duty it should be to suppress such papers, a summary of each being required before it could be presented to any section. The laxity in regard to admission soon became such as to develop the wide-spread impression that anybody of either sex could be elected to membership by exhibiting willingness to pay the usual fees.

If the term scientific aristocracy is admissible at all it was applicable to the association in its earlier days. The rapid change to democracy after the Saratoga meeting produced dissatisfaction among many, and this was manifested in the formation of the American Chemical Society as an offshoot. The interest of its members was very perceptibly withdrawn for a time from Section C, although affiliation was claimed. One after another of these affiliated societies has since been formed, until their number now considerably exceeds the number of sections of the parent association. Where the affiliated society has a field identical with that of a section of the association the two usually meet together, as a matter of courtesy, but division is still perceptible. The American Physical Society, for example, has four meetings each year, the agreement being that one of them shall be held in conjunction with Section B of the association and the others usually in New York. The chief reason alleged for the formation of the Physical Society was that many of the leading physicists of the country could not be induced to attend the meetings of the larger association on account of the lack of discrimination in its make-up. It has been repeatedly noticeable that some of the most active members of the Physical Society were absent from the joint meetings. No ground for criticism is implied in such a statement. Every one is perfectly free to attend only such meetings as are found attractive, and an appeal based on loyalty to the parent association can never be effective, especially now that the number of gatherings is so great that nobody can attend them all.

The tendency toward disintegration of the growingly unwieldy national association is not due merely to increasing diversity of interests or undue liberality in admitting those who are not specialists. The great size of our country and the consequent expense involved in long journeys make the conditions essentially different from those which seem to have maintained the unity of the British Association. Reduced rates on the railroads can

generally be secured for almost any gathering of more than fifty or a hundred persons, but in spite of this a trip from Boston or Savannah to Denver or San Francisco implies an expenditure in both money and time which is prohibitive to many. The plan advocated by the editor of SCIENCE, that each affiliated society shall send delegates to the annual meetings of the national association, is much to be commended and well worth trying, but its availability depends much upon the location of each delegate's home with regard to the place of meeting. The tendency toward the formation of separate societies irrespective of the American Scientific Association seems now to be well developed. Two of them met recently in New Orleans where they launched a third into existence. Recommendations may be made at will by those who wish to maintain unity, but the ordinary processes of evolution will continue without regard to individual preferences.

The present writer gives his hearty approval to the views advocated by the editor of SCIENCE, which have been well thought out. The policy of adaptation to the multitude inaugurated at the Saratoga meeting has had nearly a quarter of a century in which to become fixed. Whatever change may yet be developed, it will not be to the conditions of 1850. No plan elaborated by any single individual will be carried out in full, but the views of many, if given full expression, will be helpful in preparation for the Philadelphia meeting.

W. LE CONTE STEVENS.
WASHINGTON AND LEE UNIVERSITY,
January 16, 1904.

THE Editor of SCIENCE invites comments upon the article 'Convocation Week' published in that periodical on January 8. With much of the article I am in full accord, but with one matter I do not agree.

As the article in question says, there was considerable friction at the Washington meeting a year ago. Under the circumstances this seemed unavoidable. The rooms available were few in number and, naturally, the association and its sections were first provided for. The result was that at least two of the independent societies—the Zoologists and the Anatomists—were forced to put up with inadequate and inconvenient quarters. It would seem probable that similar disagreeable and irritating conditions will recur whenever so many organizations meet together. The only escape seems to be either the merging of the separate societies in the sections of the association or in their meeting apart, as several did this year.

The greatest objection to such a merger is the enormous extent of our country. The association is national in character and its meetings have been held at points as remote from each other as Portland and Denver, Charleston and Minneapolis. It is the policy of the association to meet one year in the east, the next in the west—Denver, Washington, St. Louis, Philadelphia and New Orleans. With this no one can find fault. A national society should supply all parts of our country. When, however, the matter of amalgamation is considered, it is seen that many of the members, most of whom are living on moderate salaries, must either take long journeys or forego the meetings on alternate years.

Another objection is the difference in character between the association and the independent societies. The latter are strictly professional organizations, aiming at the advancement of science. As such they limit their membership, thus ensuring audiences, the majority of whom are able fully to comprehend any paper presented. The association admits all who apply for membership, and its function, in spite of its name, has largely become that of the popularization and diffusion of knowledge. There is nothing more difficult than the presentation of the results of research to an audience which can not appreciate the points made. Again, with the smaller societies under the present conditions there is too little time for discussion of the papers presented; united with the sections of the association the program would be so long that this valuable feature would be entirely lost.

In view of these facts it seems best to the writer that the societies should retain their independence and should hold their meetings

without regard to the movements of the larger organization. They might all meet together at times and places where the accommodations were adequate, but such places would be few and far between.

Of course, this would result, under the present conditions, in a society and a section with similar aims meeting in different places at the same time and a member of both might have difficulty in deciding which of the two he should attend. But the remedy is a simple one. These separate societies have, by right of preemption, a claim upon the Christmas holidays for their meetings. The whole trouble has been caused by the American Association for the Advancement of Science, which has encroached upon this period and is now trying to force the independent organizations to accommodate themselves to its actions. All that is necessary for full harmony is that the association return to its summer meetings, leaving the Christmas vacation free to its rightful possessors.

J. S. KINGSLEY.

TUFTS COLLEGE,
January 13, 1904.

THE SCINTILLATIONS OF RADIUM.

THE phenomenon of the scintillation of a phosphorescent screen, under the influence of the radium bombardment, which was first described by Sir William Crookes, is one of the most impressive spectacles which we have had for a long time.

As comparatively few of us have had an opportunity of witnessing this remarkable sight, I have prepared about two dozen 'spinthariscopes,' which I shall be very glad to pass around among my colleagues, on the condition that they be promptly returned.

Last autumn, while experimenting with some phosphorescent materials, I found that the scintillations could be as easily seen when the radium was mixed with the phosphorescent powder (the mixture being pressed between two plates of glass) as in the usual form of Crookes's spinthariscope.

If one sits for several minutes in an *absolutely dark* room, and then examines the plate with a powerful pocket magnifying glass, the appearance reminds one of an enormous star cluster as seen in a telescope, the individual stars lighting up and disappearing in rapid succession, producing an impression which has been likened to that produced by moonlight on rippling water.

Whether the flashes are produced by the impact of the individual electrons which constitute the α rays, as was imagined by Crookes, or whether they represent microscopic cleavages which are occurring in the crystals as a result of the bombardment, as Becquerel believes, is still an open question. The fact that hundreds of flashes appear every few seconds, the action showing no signs of abatement after several months, makes it difficult to believe that each flash represents a split in a crystal, unless one is prepared to accept the doctrine of 'infinite divisibility.' It is, perhaps, equally hard to believe that the impact of a single electron is responsible for each flash. The obvious way of settling this question would be to make a rough estimate of the number of flashes produced in a given time by a very small amount of radium of very low activity, and see if the number was of the same order of magnitude as the number of positive electrons given off in the same time. If the number of emitted electrons far exceeds the number of flashes, we may find a way out of the difficulty by assuming that the electrons are thrown out in intermittent streams, the impact of each 'squirt' producing a flash.

On carefully scrutinizing the screen it is almost impossible to avoid forming the opinion that the points of light are in motion, the whole field squirming with light, like a colony of infusoria under the microscope. This appearance is, perhaps, a little more pronounced with the Crookes spinthariscope, in which a speck of highly active radium is mounted at a little distance above the screen. If this motion should turn out to be real and not illusory it could, perhaps, be explained by a slight sweeping motion of the streams of electrons emitted by the radium. Such speculations are scarcely worth while, however, in view of the very deceptive nature of illusions of motion. The plates which I have prepared for distribution are packed in small tin boxes, which can be sealed up in an ordinary envelope. Institutions desiring to borrow one will be

accommodated as promptly as possible. The limited number of plates available will of course cause more or less delay in complying with many requests. A prompt return of each plate is to the interest of all. A self-addressed envelope with four cents in postage affixed should accompany each application.

Failure to observe the phenomenon can only result from an insufficient resting of the eyes. Half an hour in subdued light such as lamplight, followed by four or five minutes in *absolute* darkness is the *sine qua non* of success.

The magnifying glass employed should have a power of five or six diameters. A Coddington lens, or Hastings triplet is suitable.

R. W. Wood.

Johns Hopkins University.

SPECIAL ARTICLES.

THE OCCURRENCE OF ZINC IN CERTAIN INVERTEBRATES.

In the course of an investigation on the chemical physiology of certain invertebrates, undertaken under the direction of Dr. Lafayette B. Mendel, it was found that the ash of the hepato-pancreas of the large carnivorous gastropod, *Sycotypus canaliculatus*, contained an element hitherto unobserved in such connection, namely zinc. So far as the writer is aware, this element has never been observed as a normal constituent of the tissues of any animal, vertebrate or invertebrate. The reaction by which zinc was first suspected was the ordinary ferrocyanide test for ferric iron in acid solutions. Not only was iron present, as indicated by the blue color, but some other metallic element as well, giving a marked slimy precipitate. Further investigation showed the presence of a heavy metal having all the characteristic chemical properties of zinc.

Quantitative separations were made difficult by the presence of very large amounts of phosphoric acid, and the basic-acetate method was resorted to. The well-known limitations of the latter make it, however, scarcely more than of qualitative value. By this method samples of ash from *Sycotypus canaliculatus* gave approximately eleven per cent. and twelve per cent. respectively of ZnO.

Further separations have since been made by means of Hampe's well-known method (slightly modified),* depending upon the precipitation of ZnS from a formic acid solution of sufficient strength to prevent the precipitation of the iron. By this method concordant results have been obtained as shown in the table below. At the same time qualitative examinations were made of specimens dredged from various parts of Long Island Sound about New Haven, and in all cases zinc was found in large quantities in the ash of *Sycotypus* and *Fulgur carica*.

Copper was estimated electrolytically in each case; in one sample by the rotating cathode method of Gooch and Medway. Iron was determined by permanganate titration in the usual way. Blanks were run through to detect the possible presence of zinc in the reagents, and great care was exercised throughout to prevent any contamination.

Other tissues besides the hepato-pancreas were incinerated and examined, and other gastropods and crustacea dredged from the same localities were also tested. With the exception of the blood of *Sycotypus*, no further occurrence of zinc has yet been detected.

The following table of ash analyses summarizes the result of the investigation as far as it has been carried.

	Samples Obtained.	Fe.	Cu.	ZnO.
Sycotypus (hepato-pancreas.	May, 1903	Present	Present	Present
Sycotypus.	May, 1903	"	8.57%	11.97%
Sycotypus.	May, 1903	"	8.17%	10.81%
Sycotypus.	Sept., 1903	"	8.47%	19.00%
Sycotypus.	Sept., 1903	"	7.83%	23.38%
Sycotypus.	Nov., 1903	0.84%	.....	18.80%
Sycotypus.	Nov., 1903	0.84%	.....	18.60%
Blood of *Sycotypus.*	Nov., 1903	Present	Present	Present
Fulgur.	May, 1903	"	"	"
Fulgur.	Sept., 1903	"	"	"
Fulgur.	Nov., 1903	"	"	"

The following other marine forms have been examined for zinc, with negative or doubtful results in all cases: *Urosalpinx cinerea, Mytilus edulis, Modiola plicatula, Argina*

* W. Hampe, *Chemiker Zeitung*, IX., 543 (estimation of zinc).

pexata, Eupagurus pollicaris, Ostrea virginiana and *Cancer irroratus.*

The significance of this unique occurrence of zinc in the economy of *Sycotypus* and *Fulgur* is still to be determined, as is the nature of the combination in which it exists. These points, together with the distribution of the element in other marine forms about the sound, are at present being investigated and will be reported upon later.

HAROLD C. BRADLEY.
SHEFFIELD LABORATORY OF PHYSIOLOGICAL CHEMISTRY, YALE UNIVERSITY.

ATMOSPHERIC NITROGEN FOR FERTILIZING PURPOSES.

OF much interest to scientific students of agricultural economy is the report of the United States Consul-General Mason, at Berlin, Germany, on a new method of producing nitrogen from the atmosphere for soil fertilization, as announced in the daily 'Consular Report,' No. 1804, issued by the Bureau of Statistics, Department of Commerce and Labor.

The gradual but ultimately inevitable exhaustion of the known nitrate deposits of South America, the report states, lends a growing interest to the methods which have been devised for obtaining a supply of nitrogen for fertilizing purposes from the inexhaustible storehouse of the air. That this can be done as a scientific process has long been known. The first method was by passing a current of air over red-heated copper, whereby the oxygen combined with the metal to form oxide of copper, leaving the nitrogen free. At first the nitrogen thus produced was fixed by combination with calcium carbide to form nitrate of lime (Kalkstickstoff) or calcium cyanimide, a combination of lime carbon and nitrogen, which had all the essential properties of a nitrate fertilizer. But as the use of calcium carbide rendered the product unduly expensive, a method was sought which would employ a substitute for that material, and this was found by Dr. Erlwein, who brought the nitrogen into combination with a mixture of powdered charcoal and lime in an electric furnace. The product of this combination is a black substance containing, besides the lime and carbon, ten to fifteen per cent. of nitrogen, in perfect condition to be used as a fertilizer. From the experiments thus far made with this new artificial nitrate—which is known in commerce as calcium cyanimide—it appears that its nitrogen acts upon plants quite as effectively as that contained in a proportionate quantity of nitrate of potassium or sodium nitrate (Chile saltpeter). The scientific problem of obtaining nitrogen for fertilizing purposes from the atmosphere would seem, therefore, to be satisfactorily solved. Whether it can be done on a very large scale and at a cost which will make it economically available for general agricultural purposes remains to be demonstrated by practical experience.

JOHN FRANKLIN CROWELL.

MISSOURI LEAD AND ZINC REGIONS VISITED BY THE GEOLOGICAL SOCIETY OF AMERICA.

AT the close of the St. Louis meeting of the Geological Society of America, January 2, an excursion to the Missouri lead and zinc regions was given by the Missouri Bureau of Geology and Mines to the members of the society whose work would allow them time for the journey. In the company several universities were represented—Alabama, Dartmouth, Kentucky, McGill, Missouri, Northwestern, Rochester, Springfield and Toronto, and several members of geological surveys were present—Geological Survey of Canada, Missouri, Ontario, West Virginia and the United States. The excursion allowed of a view of the Missouri geological scale from the St. Louis formation (of the sub-Carboniferous), through Devonian, Ordovician, Cambrian to the Algonkian, and many phases of geology, from *peneplain* to paleontology, had their share of attention. However, the chief place in the thought of the visitors was occupied by the mineral resources of the famous lead and zinc localities. A day and a half was spent in the eastern lead region—the classical locality for lead production in the Mississippi valley. A number of mines and mills at Bonne Terre and Central were visited, and the facts obtained there, when combined with those ob-

tained on the visit made during the American Association for the Advancement of Science meetings to the lead pipe works in St. Louis, gave a complete view of the lead industry, from deposits disseminated in the Third Magnesian Limestone to the finished product, to be disseminated eventually throughout the homes and shops of American cities. A dozen mines a score or two miles from the old mine LeMotte, famous in the history of lead mining in the Mississippi valley are being worked by modern methods. Companies of large capitalization are able to mine and mill successfully in a region where the individual could not afford to work, and the annual production is now measured by millions of dollars. At the St. Joe Mine a depth of 350 feet has been reached, and the workings extend about two miles from north to south. One chamber is about 130 feet in length, and furnished ore throughout its entire distance. The mines are in the Bonne Terre or lower division of the Third Magnesian Limestone—a shaly magnesian limestone about 500 feet thick, which rests on Potsdam sandstone, and is overlaid by the Potosi, or upper member of the group. The size and perfection of the concentrating and milling plants were a surprise to the visitors. Two mills were visited, each of which has a daily capacity of 1,500 tons.

Some of the party took a side excursion to Pilot Knob and Iron Mountain. The character of the iron formations reminded the visitors of similar formations in the Lake Superior region.

From the eastern region the company were taken four hundred miles to Joplin and Webb City, where sub-Carboniferous zinc and lead deposits and the treatment of their ores occupied the attention for a day. A few of the eight hundred mines in the region were not visited. The two which were examined gave an idea of the remarkable richness of the region, and explained the prosperous condition of the cities in southwestern Missouri. Picturesque names are not confined to the far west. The 'One Gallus Mine' shows such deposits of sphalerite as to make the most thorough pessimist forget his position. This region is still favorable as a 'poor man's diggings.' With almost no capital, a man can lease a plot of ground and start in to make his fortune. Yet improved methods and well-equipped mills are seen on every hand, and have as a result the addition of several millions of dollars' worth of lead and zinc to the wealth of the country.

The excursionists were shown unlimited hospitality by various organizations in the regions visited, and by five railroad companies, which not only carried the party nearly a thousand miles, but furnished extra engines and held an important train in order that our delayed car could be attached.

The value of the trip was enhanced by the unending courtesy of our 'English-speaking guides,' Drs. Shepard, Wheeler and Buckley, who were ever ready to answer questions and point out facts of interest.

The excursion was due to the enterprise of the state geologist, Dr. Buckley, to whom the visitors are under very pleasant and great obligations for the increased knowledge which they have of the geology of the remarkable lead and zinc deposits of Missouri.

A. R. Crook.

Northwestern University.

SCIENTIFIC NOTES AND NEWS.

The Lalande prize in astronomy has been conferred upon Director W. W. Campbell, of the Lick Observatory, by the Paris Academy of Sciences.

The Gold Medal of the Royal Astronomical Society of London has been conferred upon Professor George E. Hale, director of the Yerkes Observatory, for his researches in solar and stellar physics.

We understand that at its recent meeting the executive committee of the Carnegie Institution adopted the recommendation of the biological committee to establish a Department of Experimental Biology and to call Professor C. B. Davenport, of the University of Chicago, to the charge of it. The work of the department will include at present, among others, a station for Experimental Evolution at Cold Spring Harbor, Long Island, on land granted by the Wawepex Society, and a Tropical Marine Biological Station at the Dry

Tortugas. Dr. Davenport is proposed as director of the former station and Dr. Alfred G. Mayer, of the Museum of the Brooklyn Institute of Arts and Sciences, as director of the latter station. Fuller details are promised as the plans of the department progress.

PROFESSOR KARL SCHLEICH, of Berlin, has received from the University of Würzburg a medal and a 1,000 Mark prize for the discovery of a method of making surgical operations painless by what he calls the 'Infiltrationsanaesthesie.'

THE University of Giessen has conferred its honorary doctorate on Herr Hermann Strebel, of Hamburg, for his work in zoology and Mexican archeology.

A PORTRAIT of Dr. Robert Fletcher, editor of the *Index Medicus,* will be presented to the Library of the Surgeon General's office, Washington.

PROFESSOR CHANTEMESSE, professor of experimental and comparative pathology at the University of Paris, has been appointed to succeed the late Professor Proust as general inspector of the French Sanitary Service.

PROFESSOR W. F. M. Goss, of Purdue University, who has been engaged for some time in testing locomotives, has been granted $5,000 by the Carnegie Institution to carry on the work.

PROFESSOR JOSIAH ROYCE, of Harvard University, will give the following lectures at Columbia University at 4:30 P.M.

February 1, 'The Comparative Study of Scientific Concepts.'

February 2, 'General Survey of Certain Fundamental Concepts of Science; (1) Classes and Classification, (2) Relations and their Types, (3) Ordinal Concepts and Ordinal Series.'

February 8, '(4) Concepts of Transformation, (5) Concepts of Levels.'

February 9, 'Application of the Survey to Various Special Problems.'

February 15, 'Philosophical Consideration suggested by the Survey.'

DR. W. M. BAYLISS is giving a course of ten lectures on 'Enzymes and their Actions,' at University College, London.

The Sibley Journal of Mechanical Engineering has published a memorial number in honor of the late R. H. Thurston. It contains a biographical notice by William Kent; an appreciation entitled 'Our Friend,' by John H. Barr; an article entitled 'Dr. Thurston's Work in Sibley College,' by H. J. Ryan and R. C. Carpenter; an article entitled 'The Literary Work of Dr. Thurston,' by H. Diederichs; and a partial list of papers by Dr. Thurston.

THE steamship *Princess Irene,* bringing the remains of James Smithson, arrived in New York on January 20. These were transferred to the *Dolphin* of the U. S. Navy and taken to Washington. They have been deposited in the Smithsonian Institution until arrangements can be made for suitable burial in the grounds of the institution and the erection of a monument. As readers of SCIENCE know, the remains were brought to this country by Dr. A. Graham Bell, at whose instance the regents arranged for the removal, owing to the fact that the English cemetery at Genoa in which Smithson was buried was to be abandoned.

THE Rev. George Salmon, F.R.S., provost of Trinity College, Dublin, and eminent for his mathematical publications, died on January 22 at the age of eighty-five years.

WE regret also to record the death of Dr. Wilhelm Behrens, professor of botany at Göttingen.

THE sum of four thousand dollars has been granted to the Lick Observatory by the Carnegie Institution for the employment of assistants in the year 1904, in continuation of the grant of an equal sum for the year 1903.

THE daily papers report that Professor A. H. Phillips, of Princeton University, has extracted radium from carnotite, an ore found in Utah, and that an abundant supply of this ore exists.

THE observing station of the D. O. Mills expedition to the southern hemisphere, from the Lick Observatory of the University of California, was completed in October. It is located on the summit of San Cristobal, a hill 1,000 feet high in the northeast suburbs of Santiago, Chile. The elevation of the plain on which Santiago is built is about 1,800 feet above sea level. The principal item of equip-

ment consists of a large Cassegrain reflecting telescope with clear aperture of 36½ inches; a modern three-prism spectrograph; a thirty-foot Warner & Swasey steel dome, and office buildings. Spectrograms had been secured by November 1 for determining the radial velocities of twenty-five or more stars. It is expected that results will rapidly accumulate, as the equipment is devoted to this purpose exclusively. The station is in charge of Acting Astronomer William H. Wright of the Lick Observatory staff, who is assisted by Dr. Harold K. Palmer.

Sr. Francisco M. Rodriguez, director of the Museo Naçional, City of Mexico, reports several interesting discoveries of ancient remains in the valley of Mexico. In the southeastern part of the valley, a number of hieroglyphic inscriptions cut in the rock have been found. In the southwestern part of the valley Mr. Rodriguez has discovered the remains of ancient habitation sites in nearly a score of places, and also rock inscriptions which seem to date back to a remote epoch. The museum authorities have plans for the removal to the museum of the famous tablets at the ruins of Palenque.

A despatch from Yakutsk, eastern Siberia, dated January 15, says that boatmen of the expedition commanded by Lieutenant Kolchak had arrived there and reported that the efforts of the expedition to find Baron Toll on New Siberia and Bennett Islands, in the Arctic Ocean, have been unsuccessful. Baron Toll left documents on Bennett Island showing that he turned southward on November 8, 1902.

The president of the British Board of Agriculture and Fisheries has appointed a departmental committee to inquire into and report upon the present position of fruit culture in Great Britain, and to consider whether any further measures might with advantage be taken for its promotion and encouragement. Mr. A. G. Boscawen is chairman and Mr. Ernest Garnsey secretary of the committee.

UNIVERSITY AND EDUCATIONAL NEWS.

The will of the late Charles F. Doe, a lumber manufacturer of San Francisco, bequeaths about one fourth of his estate to the University of California for a library. The university will receive over $500,000.

Towards the fund being raised by the senate of the University of London for the proposed Institute of Medical Sciences, Mr. Butlin, the dean of the Faculty of Medicine, has contributed £1,000, and Sir William Church, president of the Royal College of Physicians, and Mr. Tweedy, president of the Royal College of Surgeons, £100 each.

Assemblyman Davis of the Committee of Public Education has introduced in the assembly of New York State a bill providing for educational unification and the reorganization of the Board of Regents. The bill provides that the secretary of state shall draw nine names from a box containing the names of the present Board of Regents, and the persons thus indicated shall constitute the Board of Regents, serving for from one to nine years. Thereafter one regent is to be elected each year, to serve for a period of nine years. They are to elect a commissioner of education, to serve during the pleasure of the board, at an annual salary of $7,500 a year. He shall perform the duties now devolving upon the superintendent of Public Instruction and the secretary of the board of regents, both of whose offices are abolished. The first commissioner is to be elected by the legislature. Neither the state superintendent nor any member of the Board of Regents, nor any employee or appointee of either shall be eligible.

Governor Odell has sent to the senate the report of the director of the New York State School of Forestry and a letter from President Schurman of Cornell University. In his letter President Schurman states that Governor Odell's recommendation that the experimental work be resumed subject to the condition that the state assume liability for the contracts that Cornell University has already entered into, is acceptable. The university is willing to acquiesce to a discontinuance provided it is protected against any liability on contracts which as agent of the state it has made in connection with the operation of the school.